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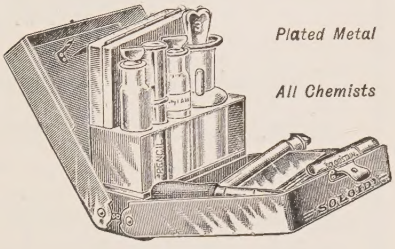

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TROPICAL DISEASES BUREAU.

TROPICAL DISEASES BULLETIN.

Vol. 4.] 1914. [No. 8.

APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

Uganda Protectorate (1913).*

Medical Section.—According to native returns, there was a decrease in mortality from communicable diseases as compared with 1912 to the following extent: dysentery 117, plague 144, sleeping sickness 224, smallpox 182. The Bukeddi special return is not included in this calculation; it notes 2,154 deaths from plague, against 1,659 reported in 1912. Syphilis accounted for 2,287 deaths and gonorrhoea for 1,669. Hospital returns showed the marked decrease of 1,01 cases.

Sub-Assistant Surgeon Vaswani died of plague after assisting at a post mortem of a case of that disease. His work is referred to by Dr. Hodges in the highest terms. In consequence of his loss, fewer inoculations with Haffkine's anti-plague vaccine were performed than in the preceding year. Plague "continues to be a source of anxiety in the Eastern Province."

The recent legislation treating syphilis as a "dangerous disease" is being put into execution tentatively and cautiously. The segregation of lepers in camp has not proved a success, and it is now suggested to segregate them in their own villages. It is not believed leprosy is on the increase. The following is a statement of important work fulfilled by Miss M. Robertson, Protozoologist:—

"She reported in the Masindi-Buruli District the existence of a long trypanosome, morphologically of the *gambiense-brucei-rhodesiense* type. This trypanosome is without doubt conveyed by *Glossina morsitans* to dogs, producing an acute and rapidly fatal disease in which keratitis is often a marked symptom. It is a most important point for investigation whether this trypanosome is, or is likely to become, pathogenic to human beings, and special attention will be directed to this during 1914. At present, however, there is no positive evidence in favour of such a supposition, and the balance of evidence is against the conclusion that this trypanosome, or any of the other forms infecting cattle and game in the same area, is a new or recent introduction."

*Uganda Protectorate.—Annual Medical and Sanitary Report for 1913. [Principal Medical Officer, A. D. P. Hodges; Medical Sanitary Officer, C. J. Baker.] F'cap. 1914: Printed by Waterlow & Sons, Ltd., London.

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Dr. TAYLOR, Medical Officer, Entebbe, in the Appendix to the Report gives a description of bronchial spirochaetosis, which had attracted his attention prior to CHALMERS and O'FARRELL'S paper in the *Journal of Tropical Medicine and Hygiene* of November 1st, 1913. He concludes an elaborate study of the cases which came under his observation with the following statement :—

"As many of the cases under observation may have been relapses, possibly a less potent and, therefore, less apparent exciting cause was required than was necessary to bring about an original attack. Stomatitis, pharyngitis, coryza and other respiratory diseases are very prevalent among the natives and others residing in Uganda, and more of these conditions may be found to be caused or complicated by spirochaetosis. Or, as is perhaps more probable, the lower resistance and suitable nidus provided by such conditions may allow parasites usually harmless to increase in numbers and virulence to such a degree that they extend down the air passages, and become of pathological importance." (See also this *Bulletin*, Vol. 4, p. 251.)

Dr. HODGES urges the important subject of allowing sufficient cubic space for prisoners in jail, and quotes the instance of Mbale, where the average cubic space per prisoner for sleeping purposes was only increased to 200 ft., notwithstanding alterations for relieving the crowded state of the jail.

Sanitary Section.—Dr. BAKER opens this section of the Report by stating that a sanitary inspector has been appointed for Kampala. This sounds a small matter, but in practical sanitation denotes the dawn of an era when applied hygiene will take the place of its theory. He notes with appreciation the advice given by Professor W. J. SIMPSON, chiefly on matters of town planning. It was held that the growth of the cotton industry in the plague endemic area represented a danger requiring early action, by the separation of cotton in warehouses and ginneries from the residential part of townships. On this ground it has been decided to reserve, as an anti-plague measure, a zone of 300 yards in width between the residential and manufacturing quarters ; and, as an antimalarial measure, to reserve a zone of similar dimensions between Europeans and Asiatics. He notes, however, that in consequence of several plots of land having been granted on long leases and permanent buildings erected on them, difficulty in application of these needful rules is anticipated. Accordingly, SIMPSON "condemned the leasing of large plots to Asiatics with permission to sublet, a practice which has resulted in subdivision of the plots and overcrowding of the inhabitants."

In regard to plague, Dr. BAKER reports that the Acting Principal Medical Officer's suggestions, which were to the following effect, received the support of Professor SIMPSON :—

"*Measures to deal with plague in the endemic area.*—Principally :—

1. Increase of the present staff to the number of three Medical Officers, three Sub-Assistant Surgeons, and thirty-five Plague Inspectors.
2. Accurate reporting of cases as well as deaths in the endemic area.
3. The continuance of inoculation of contacts with prophylactic serum.
4. Rat destruction on a larger scale.

Measures for prevention of Plague in Towns and Trade Centres :—

1. The exclusion of cotton stores, markets and ginneries from townships.
2. The control of ginneries and stores by legislation dealing with siting and construction.
3. Establishment of Isolation Hospitals and Segregation Camps at Mbale, Jinja and Kampala, and a Segregation Camp at Entebbe."

Natives readily submitted to anti-plague inoculation. Vaccine both from Bombay and the Lister Institute was received. "The latter has the disadvantage of being supplied in large phials containing 21 doses, so that when only a few inoculations have to be performed at a time a portion of the serum has to be thrown away; it is reported, however, to have given better results than the serum from Bombay, and to have been less painful on injection."

The endeavour to incinerate night soil at Kampala is reported not to be so successful as expected, and "consequently a large portion of the night soil has had to be buried."

Zanzibar (1913).*

The man of curative medicine finds his reward—very often the only one—in seeing his efforts to save life and suffering demonstrated in the person of individuals snatched from death; the sanitarian counts his slower victories by communities and ultimately by provinces and countries. Hence, both at times indulge in retrospects which tell them of the rate of progress. Thus, we find that the Health Officer, Zanzibar, Major D. S. Skelton, R.A.M.C., is able, in the introductory paragraph of his Report for 1913, to contrast favourably the present with past sanitary conditions. He states that in the mid-Victorian period "dirt, filth, and rubbish of all kinds was flung on the streets, and if one went out of one's house, one was compelled to wade through a dreadful mess. Dead bodies were cast out on the beach in many instances or, if the corpse were fortunate enough to be buried, the grave was dug anywhere in the town, whilst the richer and more important persons were buried in their own back gardens, so to speak." In contrast, he is able to show that, in the present day, complaints of insanitary conditions are freely brought to his office—a state of affairs he is only too glad to encourage.

To serve a population estimated at about 197,000, he states there was a total of 360 employees, amongst whom administrative duties were confined to four.

Financial conditions have prevented any "very striking work" being put in hand; still, Major Skelton is able to report that "a lot of quiet and exceedingly useful work has been done in clearing up and clearing away ruins by the Public Works Department." He, nevertheless, urges the great importance of "town planning" in Zanzibar. He advises early action in the case of dark and ill-ventilated huts of natives, where absence of light and the existence of "choos" in the kitchens favour the propagation of the *Culex fatigans*, with special regard to the fact that "at least 1 in 5 of the population of Zanzibar is infected with microfilaria." Moreover, a certain area of the town (which during his recent deputation to East Africa attracted the particular attention of Professor J. M. Simpson) "appears to be the focus of plague infected rats."

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* Zanzibar Protectorate.—Public Health Report for the year 1913. [Health Officer, Major D. S. Skelton, R.A.M.C., M.R.C.S.].

Major Skelton, in discussing the vital statistics of Zanzibar, points to a matter of economic importance in the decreasing birth rate of the Swahilis. Members of that community are largely trusted to for "indigenous labour supply." He offers no theory as to the decrease, but points to the fact that communities of other tribes resident in Zanzibar show no similar tendency and, finally, suggests it may become necessary for Government to offer a "baby bonus" for Swahilis, as is done in Australia. He asserts that Indians in Zanzibar are not of the class which undertakes daily labour.

Major Skelton supports Sir Havelock CHARLES'S opinion as to necessity for the European serving in the tropics being of a selected type, but considers that if this be attended to "no man who spends the best part of his life in Zanzibar, with its apparently not undesirable climate, need come to any great grief on this account."

The birth rate for the whole island for 1913 is said to have been 15·35, and the death rate 26·3. The infantile death rate was 140 per mille of registered births.

Beyond one case imported from Dar-es-Salam, there was no human plague in Zanzibar during the year. 51,000 rats were destroyed by poisoning and trapping. Fourteen rats were declared plague infected. In future, the Rodier system as well as rat poisoning will be pursued. Major Skelton here describes the method :—

"Catch the rats alive and uninjured; kill all the females and liberate the males, keeping a strict tally of the number; the tail of the male is snipped so that if caught again he can be counted out. The system appears to depend on the fact that rats have become a pest because they are polygamous, just as rabbits have in Australia. If they become polyandrous they will cease to be a nuisance, because as soon as the number of males exceeds that of females, the males will persecute the females and eventually they will worry them to such an extent that the female cannot breed. The male will also kill what young are born. Finally, there should practically be no females left and so the pest will cease. This is what has happened in the case of rabbits. The plan anyhow is worth trying."

A total of 22 cases of smallpox occurred, but wide spread was prevented by removal of both patients and contacts to Gulioni Hospital, vaccination of all house contacts, house-to-house search for cases, and disinfection of infected houses. Vaccination (nature of vaccine not stated) was not so successful as in previous years, which Major Skelton ascribes chiefly to an inferior strain of vaccine being employed.

Tuberculosis makes itself felt in the town population of Zanzibar, but the number of deaths from this cause shows a steady decline since 1910. Cerebro-spinal meningitis was prevalent amongst the Kikuyu in the highlands of East Africa. Quarantine of 14 days was enforced against the Kikuyu proceeding to Zanzibar via Nairobi. Major Skelton, as a result of experience gained at Mombasa, believes the disease cannot "flourish at the temperature we get at Zanzibar." As to the existence of filariasis, Major Skelton points to the importance of improved conservancy in that the cesspools and "choos" of the town offer breeding places for the *Culex fatigans*. He holds it is out of the question to oil regularly 3,000 and 4,000 cesspits in the town, and "as long as we have cesspits so long shall we have filariasis and its sequelae."

In regard to malaria prevention, it is stated that the barracks of the King's African Rifles are surrounded with swamps affording suitable breeding sites for anopheles. Major Skelton then suggests that no surprise will be felt at perusal of a table he appends. This gives the "fever" history of 24 officers and two ladies. If the case of one officer living in barrack quarters for 18 months and suffering from monthly attacks of fever be excluded from consideration, it is found that on a residence extending from two to nine months in the barracks 13 contracted fever and two escaped; the remainder lived in town and so were not attacked, so far as records existed. Of the total attacked three officers were invalided. No mention is made in the Report of any attempt at drainage in these particular swamps, or in any other part of the islands. After March, 1913, oiling by a "mosquito brigade" has been carried out in the town at a cost limited to £400 per annum. Judging by results to the end of the year, Major Skelton considers the method satisfactory.

The number of lepers in the island is estimated at 450. Of these only 268 are under control. Major Skelton enforces the inutility of such partial measures by stating that the various leper settlements cost in the aggregate Rs. 30,000 per annum—"money spent without getting very much in the way of returns." He advises concentration upon a selected island and the provision of treatment for lepers.

Nyasaland (1912–13).*

This Report opens with the statement that, although malaria still continues to be the chief disease among Europeans, severe attacks are becoming noticeably rare—a result which is ascribed to increased attention to quinine prophylaxis. There were ten cases of blackwater fever amongst Europeans against one Asiatic attacked. In all the eleven cases, there was a history of previous attacks of malaria. In the Ruo District, Dr. Sanderson examined blood films of natives after 8 p.m. and found embryos of *Filaria bancrofti* in 27·8 per cent. In the positive cases, there was no accompanying elephantiasis.

In the "proclaimed area," the incidence of sleeping sickness upon a population of 1,500 adults was in 1910–11, 1·96; 1911–12, 1·62; 1912–13, 4·09 per cent. In a population of 3,000, the rates for the same years were respectively 1 per cent, 0·83 per cent., and 2·1 per cent. Dr. Hearsey does not, however, accept these figures as conclusively showing increase of trypanosomiasis, as with increasing trust of European intentions by natives more cases are likely to exhibit themselves. He hence counsels further investigation; and especially indicates the desirability of examining the population of districts immediately adjoining the proclaimed area. After alluding to the fact that the Medical Officer in charge of sleeping sickness investigation at present is engaged "in mapping out the natural features of the country" so far as to facilitate clearing operations, he states:—"The clearings which have recently been made around villages in the area have been attended with the best results;

*Nyasaland Protectorate: Annual Medical Report on the Health and Sanitary Condition of the Nyasaland Protectorace for the year ended 31st March 1913. [Principal Medical Officer, H. Hearsey.] F'cap. 1913: Printed by Waterlow & Sons, Ltd., London.

Dr. CONRAN in his recent report stating that the cutting down of bush and scrub and the lopping of branches of overhanging trees had produced a very appreciable diminution in the number of flies from the immediate neighbourhood of these villages." Compared with the Uganda type, he holds that the disease is "uniformly progressive and rapidly fatal." Three cases of typhoid occurred in Europeans and two in natives.

In connection with the recent inspection of the Transvaal Mines by Surgeon-General GORGAS and the extent to which Nyasaland supplies labour for these, it is of interest to find that the men on return to their native country are being carefully examined—chiefly by Dr. OLD. Of 1,274 it was found that 3·01 per cent. were phthisical, and 9·5 were returned as "suspicious." Whilst no reason is found for disagreeing with the opinion of the "Medical Society of the Transvaal" that "tuberculous condition is accidental and only seen in a minority of cases," the highly desirable precautionary measure has been taken of warning Medical Officers and Residents to keep all cases under observation, having regard to the "lowered vitality of the damaged lungs in pneumokoniosis."

The first local case of dracontiasis was discovered in the case of a man of the King's African Rifles. The helminthic researches of Drs. CONRAN, STANNUS, BURY and SANDERSON show that in the various districts ankylostomiasis is present in from 16·8 to 40·4 per cent; schistosomiasis in 4·9 to 32·3 per cent. The importance of correct night soil conservancy in relation to ankylostoiasism is fully recognised, and the method advised by Dr. Andrew BALFOUR, in which both refuse and night soil are disposed of by incineration, will probably be adopted.

CYPRUS (1913).*

Special efforts have been made by the Chief Medical Officer to improve the accuracy of vital statistics as a step towards efficiency. He reports that the registering agency (Muktars) are being better paid than formerly. Whilst not claiming that accuracy has yet been secured, he considers the returns for 1913 are more trustworthy. In a population of 286,442, the registered birth rate was 29·4 and the death rate 18·8 per mille.

An impetus was given to anti-malarial work by the deputation of Sir Ronald Ross. Some anti-malarial action had, however, been taken previous to his arrival in obtaining a spleen census amongst children, and the free distribution of tannate of quinine. On the advice of Ross, the spleen census was largely extended so that a total of 18,981 children was examined. The total average spleen rate was 17·2; but the items indicate 1,542 and 4,383 children with spleen rates of 49·73 and 27·6, respectively. In Voroklein in Larnaca District and Spatharico in Famagusta District, a rate of 100 per cent. was found.

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*CYPRUS.—Annual Medical Report for the year ending 31st December, 1913. [Chief Medical Officer, R. A. CLEVELAND.] F'cap. 1914: Printed by Waterlow and Sons, Ltd., London.

Five "probationary Sanitary Officers" were trained for anti-malarial work. Larvicides were freely employed. "Drainage of certain swamps and marshy places was carried out" in the Limassol and Larnaca Districts, but the chief efforts were confined to the towns and their neighbourhood. It was found that, judging by attendance of patients at Government Dispensaries, there was a decline of malaria fever cases from 10,035 in 1912 to 7,342 in 1913. Dr. CLEVELAND places no stress on these figures, as meteorological conditions might well have dominated the result. Yet he holds that when the figures for towns where the chief efforts were made are considered, there is reason to believe that notwithstanding the short interval between the inauguration of efforts (March) and the close of the year, they have been efficacious. Thus, according to the Dispensaries record in the towns, the malaria cases for 1913 were 4,356 against 5,819 in 1912.

Twenty-five cases of epidemic cerebro-spinal meningitis and 21 cases of diphtheria were under serum treatment during the year. Typhoid fever cases decreased from 447 in 1912 to 338 in 1913. The prevalence is ascribed to the consumption of water from unprotected shallow wells.

CEYLON (1912–13).*

The population of the Island, according to the 1911 census, was 4,106,350; as estimated on July 1st, 1913, it was 4,220,459. The birth rate was 36·2 and the death rate 28·7 per 1,000. On the estates, where 507,189 unindentured labourers were employed, the birth rate was 35·4 and the death rate 39·3 per 1,000. The chief causes of death amongst labourers and their families were dysentery (3,038), diarrhoea, pneumonia (1,688), ankylostomiasis (1,586), infantile convulsions (1,305), phthisis (235).

There was a decrease of 81,182 patients treated for malaria in the hospitals as compared with the previous year; but there was a severe outbreak in the Western Sabaragamuwa and Central Provinces. Of quinine 109,942 ounces were issued from the Civil Medical Stores, at a cost of Rs.66,766. On the estates quinine is issued free of cost; in several of these sanitary improvements have been effected. In the Island generally, the average spleen rate in 96,115 children under 15 years of age was 25·74 per cent. Kala azar is reported to exist "to a very slight extent."

Beyond the issue of quinine through village headmen and to schools, no very earnest anti-malarial effort seems to have been made by the public authorities, and Sir Allan PERRY concludes that, although "a slight decrease in malaria has been recently noticed in the majority of the provinces, this is more apparent than real." He records that the Kurunegala campaign has not been continued; that in Badulla "by methods of a small gang of labourers operating as a mosquito brigade the town has been largely freed from mosquitoes"; and that "a number of additional wards were fly-proofed in hospitals."

*CEYLON.—Administration Reports, 1912–13. Part 4.—Education, Science and Art. Medical. [Inspector-General of Hospitals, Sir Allan PERRY, M.D.]

He, however, sounds a more hopeful note by adding to this summary of anti-malarial measures: "The Sanitary Branch of a Department which had just begun operations before the end of the period will, in addition to their own staff, work through the already existing machinery."

Testimony is borne to the great value of Sir Leonard Rogers's "discovery of emetine in the treatment of amoebic dysentery." The disease is said to be prevalent all over the island, "particularly in the planting districts." This is ascribed to the use of shallow and unprotected wells as sources of water supply. As to ankylostomiasis, it is held that "the lack of a conservancy system is one of the chief factors in the spread of the disease." Elsewhere it is stated that of the many sanitary errors "defective conservancy stands out pre-eminent." This important question is thus summarised:— "As satisfactory system of conservancy, the domestic pig and cesspits are not only worse than primitive, but create new foci of disease dissemination which would not otherwise occur." Anti-tuberculosis action has received much support in the gift of a sanatorium by Mr. A. E. De Silva, at a cost of Rs.60,000.

The Bahamas (1913).*

The Chief Medical Officer, with the object of training a newly-appointed Sanitary Inspector as well as gaining first-hand knowledge of conditions in Nassau, undertook a house-to-house inspection in a central portion. He inspected 466 houses. As to water supply, he found the people dependent on dug wells, "few of which were properly protected from surface pollution or from mosquitoes." In 20 per cent. of these wells mosquito larvae were found, those from which water was drawn by buckets being less subject to infestation than those having imperfect covers and pumps. In quality the water is hard and polluted. Tanks and underground cisterns for receipt of rain water were employed, but the majority were very dirty and imperfectly mosquito screened. *Culex fatigans* and *Stegomyia fasciata* were well represented. Natural holes in rock were not found to be favourite breeding places for mosquitoes, and "the presence of tadpoles seemed to be the explanation of the scarcity." Dr. McHattie has seen the tadpoles devouring larvae, and is of opinion that the "seasonal variation in the number of tadpoles probably accounts largely for the greater prevalence of mosquitoes at one time than another, other conditions such as the amount of rain, etc., remaining the same." He ends this section of his Report by a strong plea for not allowing "considerations of economy" to stand in the way of effective action being taken against the *Stegomyia fasciata*, in view of the possible incursion of yellow fever and the disastrous influence on local commerce and the position of Nassau as a winter resort. So far no anopheles mosquitoes nor larvae have been found, but a blood examination shows that true malaria exists; further search for these will be made.

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*Bahamas.—Annual Medical Report for 1913. [Chief Medical Officer, A. C. N. McHattie.

The privy pit is commonly used in the backyards of houses, and as these are small and the houses much crowded together the condition is "deplorable." Cesspools are also employed, many being converted wells. These are in porous rock 8 to 10 feet deep. The porous condition of rock has tempted some of the people to indulge in water-closets, notwithstanding the absence of a sewerage system. These closets are made so as to be flushed into the cesspools. These are universally condemned "as a menace to the health of the community," and Dr. McHattie now requires, as a condition for the use of water-closets, that the cesspools employed be rendered water-tight and be trapped and ventilated. But, recognising that the employing of these improved cesspools remains a problem, he urges either "the aid of a proper suction apparatus or the laying down of a proper sewerage system." He adds: "Not only would the w.c. drainage be rapidly carried away, but also the drainage from bath wastes, kitchen sinks, etc., which now frequently finds its way into the surface drains at the sides of the streets, giving rise to constant complaints of nuisance. These surface drains are only intended to carry off storm water, and with their uneven bottom and slight gradient are quite unfitted for the reception of dirty water." He pushes home his arguments as to this unsatisfactory state of affairs by inviting attention to the fact that "the recurrence, year after year, of sporadic cases of typhoid fever should be taken as a warning, which cannot be neglected indefinitely." Happily, he is able to look forward to the possibility of a pure water supply as the subject is under investigation.

Besides his personal inspection and practical recommendations founded thereon at Nassau, Dr. McHattie made a tour of inspection extending over a month in the small islands of the Colony. His Report should be of particular utility to the civil authorities concerned. He ascertained that in one area there had been no vaccination for 10 or 12 years, in another that the "Local Board of Health" has never assembled for 25 years. At two meteorological stations, he discovered that the methods of measurement of rainfall were absolutely erroneous. In another area he found that a medical officer—"the ex-officio Chairman of all the Local Boards"—was expected to visit out-stations, but was given no travelling allowance, with a very natural sequel of this duty being held "impossible." The sanitary condition of schools and conservancy arrangements of these and of certain private dwellings were radically bad.

Trinidad and Tobago (1912–13).*

The mean population at mid year of 1912-13 was estimated at 336,827. For statistical purposes, this is divided into the "general population," 228,114, and the "Indian" (here known as East Indian), 117,283. The birth rate was 34·16 per mille, the death rate 30·3.

*Trinidad and Tobago.—Report by the Surgeon-General on the Medical Department for the year 1912-13. F'cap. 1914: Printed at the Government Printing Office, Port-of-Spain.

" Infant mortality shows a heavy increase on the figures for the previous two years, the rate per 1,000 births being 202 compared with 149 and 148 in the last two years respectively. Children under five years of age died to the number of 1,520 and the total child mortality of 3,886 out of 10,295 deaths at all ages is a disquieting proportion equal to 37·9 per cent. of the total deaths, which means that out of every 100 deaths in the colony within the year nearly 40 were deaths of children under five years of age. This heavy annual charge upon population increase constitutes one of the most serious of the problems that affect the economic development and the material progress of the Colony. The figures are not available for referring the relative proportions of these deaths of young children to the general and the East Indian divisions of the community respectively."

Epidemic dysentery prevailed in seven medical districts, " especially in Chaguanas and the Naparimas, where a virulent type of the disease prevailed and mortality in the early stages of the epidemic was high." Enteric fever was also " usually prevalent " in some districts. The Surgeon General considers that the information obtained as to sanitary environment and general conditions is seldom of much value in etiological respects. " It is worthy of note, however, that there is a public water supply under exclusive control of the authority who supplies it in four out of the six districts where enteric fever prevailed to an unusual degree this year, namely, in Port-of-Spain, St. Joseph, Tacarigua and North Naparima."

Malaria is of a benign type, but is considerably in evidence. Quinine prophylaxis has been adopted in a " desultory fashion " by certain of the estates, whilst the cisterns and wells of Government buildings are screened. The Medical Officers of six districts report increase of ankylostomiasis. There have been no cases of plague since 4th July, 1912. Continuous measures are maintained against the Stegomyia and no yellow fever cases have been reported. 2,000 cases of yaws were treated with salvarsan," without any ill effects."

At the close of the year, the West Indian Intercolonial Tuberculosis Conference was held in Trinidad. " There were 18 delegates from the West Indies and British Guiana and neighbouring countries, and Dr. Cecil Wall was accredited by the Secretary of State as the delegate from Great Britain." A bright future is looked forward to if the recommendations of the Conference are put into operation.

The Port Health Officer, Dr. C. F. Lassalle, had apparently a busy time during the year, as 435 vessels and 4,331 packages of passengers' baggage were fumigated ; also, 13,363 passengers and 9,184 members of crews were inspected on arrival. 3,470 persons were placed in medical surveillance, and there was a total number of 12,843 " presentations for medical supervision."

The tables attached to the Report show that of 14,215 rats bacteriologically examined, two only were found plague infected. Their examination was conducted between the 1st April, 1912, and the 13th March, 1913. During the same period, there were 11 cases of human plague in various localities.

St. Kitts, Nevis and Anguilla.*

St. Kitts has a population of 26,283, Nevis of 12,945 and Anguilla,

*Medical Report on the Sanitary Condition of the Presidency of St. Kitts-Nevis and the Island of Anguilla, Leeward Islands Colony [Senior Medical Officer, M. H. Fretz, L.R.C.P., L.R.C.S.]. F'cap. Printed by the St. Kitts Printery, St. Kitts, W.I.

4,075; their respective death rates in 1913 were 30·9, 28·5 and 18 per mille. Leprosy and yaws are specially noted as occurring, but beyond the fact that 61 cases of leprosy were in the Leper Asylum there is nothing to indicate the extent of prevalence. Syphilis, it is stated, is very prevalent, seriously affects the vitality of the population, and constitutes a social danger. The salvarsan treatment of yaws and syphilis is trusted to. Dr. Edward Branch reports a case of tertiary syphilis complicated with elephantiasis where improvement of the latter condition was marked after treatment by salvarsan.

British Guiana Tuberculosis Report.*

The Colony of Guiana eminently deserves the qualifying adjective of British. Those who have followed its struggle to develop its resources and to remove the impediment of imported labour being subjected to insanitary conditions, must recognise its determination not to "go under." It is not therefore surprising to find that the Society bearing the above title is able to state that the recommendations of the West Indian Intercolonial Conference on Tuberculosis of 1913 have been anticipated in British Guiana:—

"The Society has pleasure in reporting that all these measures were in force during 1913. Notification of tuberculosis patients has existed for two years, the establishment of a tuberculosis dispensary was accomplished seven years ago, excellent bylaws regulating the milk supply have been enforced for a year; the elements of sanitation and hygiene have been taught in the schools for four years, registration of births and deaths has been accomplished for over 30 years.

"Housing reform is particularly referred to, and the attention of the municipality of Georgetown was especially directed to this matter during the year. In consequence 565 premises have been dealt with."

The Report claims attention to the reduction of mortality shown in the Colony between 1907 and 1913. The phthisical death rate per 1,000 of population was in successive years of the period 2·7, 2·3, 2·3, 1·9, 1·3; the last figure "approaches within measurable distance of England, in which country the rate is 1·1 per 1,000 persons living."

*British Guiana.—The British Guiana Society for the Prevention and Treatment of Tuberculosis. Seventh Annual Report. 1913.

DISEASE PREVENTION.

Malaria.

North Carolina.

The following extracts from a Report of a sanitary survey in North Carolina by H. R. Carter,* Senior Surgeon, United States Public Health Service, are of utility in giving practical support to more or less accepted anti-malaria measures. In reference to increased prosperity of the people concomitant with decrease of malaria and consequent increase of energy, it is stated :—

"They have cleaned up and drained more land, and it is kept for economic reasons freer from standing water and brush, hence of breeding places and shelter for mosquitoes. Surface wells have been replaced very generally by driven wells and pumps. Much stress is laid on this latter change by the physicians of this section. That these wells would furnish shelters for mosquitoes is certain. . . . Something must be said about the top minnows, which in my opinion are most valuable allies to the sanitarian in his anti-malarial campaign. They are found all over tidewater (North Carolina), and in myriads. They are not only in every stream of running water, no matter how slowly it runs, but in a large number of pools—big and little—which have no effluent. There are no larvae found if they can get at them. Unfortunately they do not penetrate thick grass, and the edges of streams harbouring this fish will sometimes show larvae. . . . It is an error to put fish that grow large, I mean such as will eat the minnows, in ponds and streams as a protection against mosquitoes.

"All the towns I visited in the tidewater section, except Plymouth, have a rather wide fringe, from 150 to 300 yards and more, of negro houses between the residences of the whites and the marshes which lie on their outskirts, and I am inclined to think, in spite of the number of carriers among the negroes and the opportunity this gives for infecting the Anopheles, that they, the negroes, are a protection to their white neighbours more distant from the breeding places; that very many Anopheles stop at the nearest blood food available. This question, of course, has not been worked out, but the mill tenements rarely have such a fringe of negro houses, and are reported to have decidedly more malarial fever than other whites in towns so protected, even when about the same distance from the marshes. This disposition of the houses of the races comes from the lower rents of houses next to outskirts, due probably to their being more unhealthful to whites†. . . . Where available, waste from the dye plants of cotton mills was recommended to be turned into ditches and streams. If turned into a marsh it does little good unless the marsh has been drained into an effluent ditch. Even the wash water from negro laundresses, living as they do thickly on the outskirts of towns, is of value in the adjacent ditches. At Edenton and Fayetteville two otherwise difficult ditches have been rendered safe by dye waste and at Washington one by the discharge of gas tar into it. . . .

"Also, as malaria lessens prosperity increases from the increase of energy and strength of the people, and with increased prosperity come land better cleared and better drained, better living, and better hygiene generally, especially that against malaria, another endless chain for betterment in anti-malarial work. . . . Although the elimination of the mosquito is the method of election in an anti-malarial campaign where practicable, yet I believe the prophylactic use of quinine is capable of much good. . . .

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*Carter (H.R.). Malaria in North Carolina.—*U.S. Public Health Reps.* 1913. Dec. 19. Vol. 28. No. 51. pp. 2739–2760.

†This observation contrasts with the usual belief that the propinquity to "whites" of races less observant of health requirements favours spread, amongst other diseases, of malaria. Evidently, as stated by Senior Surgeon Carter, although the evidence is suggestive, a decision cannot yet be arrived at.

"I demonstrated Anopheles larvae in various places and made a complete survey of the town. I found here a number of collections of brown water, with a slight taste of tannin, in which I found no larvae of either Culex or Anopheles. There were many breeding places, however, elsewhere, especially in the pools in the ditches. In one place about 50 Anopheles larvae, full grown, and some as pupae, were found in what was really thin mud, the water having evaporated to the consistency of sirup . . . . I remained over four and one-half days in all at this place, to talk over the plans for its sanitation with the mayor, health officer, and the different mill owners and help them formulate plans for co-operation in this work. They all agreed, and it is unquestionably true, that the lessened loss from sickness and the increased efficiency which will result from eliminating or nearly eliminating malaria here will justify a considerable expense. That the mayor is an engineer, and that the mill owners are business men, used to investing money for the sake of getting returns, makes the prospects good for results here."

The Panama Canal.

The Report of the Department of Sanitation of the Isthmian Canal for December, 1913, shows in chart form the rate of decrease of malaria "as an index of practical anti-malarial operations." The chart is stated to have been compiled "by adding monthly percentages of force sick with malaria." The rates are :—

Years.	Per cent.	Years.	Per cent.
1906	82	1910	19
1907	43	1911	19
1908	28	1912	11
1909	22	1913	8

Algeria.

Dr. Hybram (*Campagne anti-paludique de* 1912, Gouvernement general de l'Algerie) reports that in Dour Ain Khiar the native school is situated on a slope in the neighbourhood of a marsh. Both Culex and Anopheles are found in swarms. Screening and quinine prophylaxis had been advised by the local Medical Officer in 1908. He reports completion of screening of the school and the house of the schoolmaster in 1909. Special arrangements were made to treat the scholars with quinine during their holidays. The total period of observation extended from May, 1912 to January, 1913. He personally directed the number of tablets of quinine each scholar should take, leaving however to the discretion of the quinine distributor to increase or diminish the dose according to the necessities of individual cases. Quinine was administered three times weekly. When two tablets per day were administered, one was given in the morning, one in the evening. In 79 scholars observed, 28 possessed enlarged spleens (seven of which were very large), 12 were cured, 11 were practically cured and five exhibited no change.

In the same volume there is exhibited a general enthusiasm by the reporting officers as to the advantage of quinine prophylaxis For example, D. Carrega states that at Penthièvre, whilst in the autumn and winter of 1911 attacks of fever were both numerous and severe, in 1912 there was an abrupt and long sustained cessation of cases. The various measures of prophylaxis were much relaxed : they consisted of some works of drainage and rough canalization of marshy lands, without the aid of oiling. Individual prophylaxis by quinine was alone pressed in respect to scholars and 145 natives.

In the editorial notes (*Etudes epidémiologiques*) on the various reports, however, attention is drawn to the fact that the winter of 1911–12 was exceptionally dry, and that during 1912 there was a diminution of mosquitoes. Nevertheless, in two areas the opposite was the case. At Maison Carrée, owing to the level of the Harrack river having fallen, the number of pools of stagnant water on its banks was more numerous than in preceding years. In these pools larvae-eating fishes are rare, though common enough in the stream itself. Similarly, the water level at the barrage of the Fergoug river having fallen, stagnant pools were formed in the mud, where the breeding of the mosquitoes proceeded uninterrupted by the fish confined to water of the barrage.

Much attention has been given at Mondovi to the question whether the area near the railway station is subject to invasion by mosquitoes imported by trains passing through infested regions. It was found that the trains traversing the marshy tracts in the neighbourhood of the lake Fitzara are invaded in the early morning and at twilight by swarms of Anopheles, and that these are often transported in the waggons for long distances.

Treatment of Swamps.

Dr. Watkins in charge of the Pemba Division, Zanzibar, makes the following statement showing how the valuable method of "oiling" as an anti-malarial measure may be discredited by failure to discriminate phases of applicability :—

"Kerosining swamps is really a useless expenditure. This may seem an absurd statement, but if the facts be borne in mind, that in no case is a single swamp properly channelled or graded, its truth is obvious; for every shower washes out the contents of the puddles and makes them ready for the next brood of mosquitoes. Until some systematic attention is given, it is useless, unless the general health of the community can be really benefited, and the money spent at present is a sheer waste."*

Anti-Malarial Works in India.

In their Resolution on sanitary administration of the 23rd May, 1914, to which reference is made under "Sanitary Organisation," the Government of India indicate that besides encouraging the use of quinine by populations and minor anti-malarial methods, they advise that "notwithstanding the initial expense, those anti-malarial measures should be chosen which will act automatically, be independent of outside help and permanent in their effects." Presumably, under this comprehensive definition, the wide employment of major and minor sanitary engineering works for the relief of surface and subsoil works is contemplated. The Sanitary Commissioner for the United Provinces, India, is thus able to state in his Annual Report for 9131 that anti-malarial permanent works are now in progress in Saharanpur Nagina and Kosi. The results that may be achieved will be of great sanitary interest. Surgeon-General Sir Pardey Lukis, I.M.S., at the last All-India Sanitary Congress, quoted an illustration of the efficacy of the policy now contemplated by pointing to the good results of old

*Zanzibar Protectorate.—Medical and Sanitary Report for the Year 1913. p. 60.

drainage works at Merut. In the King's speech at the Delhi durbar, reference was also made to drainage of a marsh in the neighbourhood of the city, which has been effected as an anti-malaria measure. As an illustration of work of former days in India may be stated the case of Kampti, where in 1829, in response to an urgent requirement for action by the Secretary of State, drainage of a swamp in front of the European Infantry and Artillery Barracks at that place was recommended by a Committee, and duly carried out. At that time in Kampti the European troops sick admission rate was 239 per cent. ! The result of the drainage was fully satisfactory. The Honourable East India Company had no hesitation in recognising the utility of works, destined for irrigation, being so constructed and administered as to favour correct disposal of surface water and prevention of interference with subsoil water, with the object of preventing the propagation of malaria. On the advice of the Dempster Committee in 1845 that Government sanctioned, *in sanitary interests*, a sum of one and a half millions sterling as an addition to the estimate for the then contemplated great Ganges Canal.

Malaria and Irrigation.

It has long been recognised that large areas in tropical countries are under irrigation without malaria following in its wake and, on the other hand, that its introduction may be followed by intense malaria. The " why and wherefore " of the difference may depend on local factors yet unexplained ; but the writer, speaking from experience of both malarious and non-malarious areas under irrigation, suggests that a study of the question is not likely to bring forth important unrecognised factors, but rather a decision as to which of those already recognised happens to be predominant in a specified area.

The following is a recent instance of malaria following irrigation, as stated by Lt.-Col. C. E. Williams, I.M.S., in the Report of the Sanitary Commissioner with the Government of Burma for 1912 :—

" Enquiry elicited the information that ever since the Môn Canal was opened for use by the agriculturists of the district in July 1911, mortality has been increasing in the area served by it. . . . There can I think be little doubt, after a study of the mortality returns of the district for the two years under consideration, that the spread of malarial infection of a virulent type was directly associated with the extension of irrigation in the district. . . . Investigations carried on in December and January disclosed the fact that the vast majority of the children in the infected villages had enlarged spleens, and a spleen rate little short of 100 per cent. was frequently met with even as late as the end of January. Adults examined by me in January rarely showed an enlarged spleen. . . . Many adults succumbed to the disease, which was in a number of instances accompanied by symptoms such as dropsy and loss of power in the leg muscles, accompanied by loss of reflexes, suggestive of beriberi."

Yellow Fever.

In the *U.S. Public Health Bulletin*, No. 64, of February, 1914, rulings on " Quarantine Procedure to aid masters of vessels in complying with the United States Quarantine Regulations " are set forth. In language devoid of technicalities, methods are laid down as to procedure before arrival in port of vessels having on board cases of plague, cholera, yellow fever and smallpox. The chief point of interest in

the brochure is, however, a map of the world on which are shown, from statistics available in the U.S.A. Public Health Office, the various localities affected with plague, cholera, and yellow fever between 1909 and 1913.

This map shows in a manner more definite than much writing could secure how widespread plague has become since it started on its world-wide tour in 1894 from Hong Kong. Yet in the "'seventies" it was customary to quote this disease as conquered by improved hygiene!

In a note on this map it is stated "the yellow fever mosquito is found nearly everywhere, but especially between 38° N. and 38° S. latitudes." This area is defined by curves. In reckoning possibilities of yellow fever extending to India, some criterion can be gathered from occurrences during the period 1909–13. The possibilities are obvious; the probabilities, which must depend on the multiplication of possibilities by trade facilities, are, however, of a consoling nature. Thus, on the West Coast of Africa, yellow fever occurred at Bathurst, Freetown, Sekondi, Lagos, Forcados.* In this connection, it is noteworthy that "for all practical purposes" Hong Kong maintains no *Stegomyia fasciata*, it being held that, although "there has been ample opportunity for *Stegomyia fasciata* to arrive and establish themselves . . . . . the results of the search, so far as it has gone, show that they have failed to do so" (p. 160, *Report of the Advisory Committee for the Tropical Diseases Research Fund*, for 1913). In a report dated the 6th March of the present year, the Government Bacteriologist, Hong Kong, states that up to that date "two separate samples have been found widely separated from each other in the City of Victoria."†

Kala Azar.

At page 363 of a recent Sanitation number of this *Bulletin* (1914, No. 7, Vol. 3), the question was discussed how far sanitary conclusions could be based upon a paper by Lieutenant-Colonel Sir Leonard Rogers and Dr. J. Dodds-Price as to results of segregation measures for kala azar. In the *Indian Medical Gazette* for August of this year, under the title "Segregation and Kala Azar, a useful Measure," Major W. McCombie Young, I.M.S., Deputy Sanitary Commissioner, Madras, shows that from 1909 onwards successful action has been taken in respect to the civil population by placing at disposal of the healthy in infected areas houses "built upon a new site at a minimum distance of 50 yards from the old site, and in many cases at a quarter distance." The old houses and all apparel and articles liable to shelter parasites were burnt—compensation being given by Government. In his statement, the same blanks as to sanitary conditions of the respective new and old infected sites are found as in the paper by the first mentioned authors, so that, in the presence of conflicting theories as to causation, it is impossible

*On the East Coast of Africa, Kisumu, Mombasa, and Nairobi are also, by a mistake at the hands of the printer, credited with cases of yellow fever. In so complicated a mass of statistics there was plenty of room for such slips. It was recognised and corrected by the Bureau of the U.S.A. Public Health Reports of January 9, p. 88, and of June 26, 1914.

†In a recent Report from Dr. Harold Macfarlane, Government Bacteriologist, it is stated that *S. fasciata* has been found in 53 places in Kowloon in 1914, and three times in Victoria.

to conclude which is supported by the evidence now recorded. A noteworthy difference from ROGERS and DODD-PRICE'S methods is, however, mentioned, in that no scruple was felt in allowing an infected member of the family to accompany the healthy members to the new site, with the provision of a separate sleeping-room and advice that the infected members should not have their meals with others. Such advice given to members of a free civil population *might* be adhered to, but the chances are, the writer thinks, much the other way. Nevertheless, the result of the advice is thus summarised :—" Of forty families removed to new sites three years ago, a recurrence of the disease in a person not obviously infected upon the old site has occurred in only one case."

In a review obviously devoid of bias the author claims that, whatever view of the matter be taken, " site infection " appears to play an important part in the propagation of the disease, and advises " further attention to the apparent usefulness as a public measure of the removal of infected families to new houses in uninfected sites." The issues are thus narrowed, leaving the case typically one in which sanitarians aided by field laboratories should, in the interests of sanitary research, investigate the subject on the spot, as contrasted with the confining of attention to clinical laboratories, where the effort to construct a scientific curative treatment is apt to over-shadow the public health aspects of the enquiry.

PLAGUE.

Destruction of Rats.

The Rodier theory, which is referred to in the preceding pages in the abstract of the Zanzibar Report by Major SKELTON, is of course very " neat "—the sequence of events expected is definite. Before, however, applying it to an important part of an anti-plague campaign, as suggested in Zanzibar, it would be well to ascertain whether the theory and facts are in accord as to rabbits and, if so, whether they are equally applicable to rats. Taking New South Wales, within which area Mr. RODIER tried his scheme, as reasonably representative of Australia, it cannot be said that his theory as to rabbits has stood the test of practice. In the *Agricultural Gazette of New South Wales* of July 2nd, 1890, is recorded the results of a carefully conducted experiment by James D. STEWART, M.R.C.V.S., Government Veterinary Surgeon. Rabbits were duly observed in pens under the conditions required by Mr. RODIER. In a summary he states :—" 1. The preponderance of males tended to decrease the number of young. 2. The males when in excess did not worry the females to death. 3. The males did not worry each other to any great extent."

In his " Comment " on the subject, after attending to the theory of " cross heredity of sex "—" the doctrine of which is that the better nourished and superior parents tend to produce the opposite sex "—he adds: " It is therefore obvious that, unless extensive destruction of females is continuously carried on, the sexual balance soon becomes restored. . . . It would appear that the method . . . entails prolonged and continuous destruction of females, while the chances of ultimate success seem to rest in a pertinacious effort to take the last doe."

Some idea of the length of time required for this pertinacious effort under favourable conditions, viz., the use of wire fencing, which should greatly diminish the chances of entrance to an area of fresh rabbits, is afforded by a Report in the above mentioned *Gazette*, dated the 2nd August, 1906, by Mr. D. W. Hatton, Government Stock Inspector, Bourke. This official visited Mr. Rodier's farm and, after careful inspection, concluded that any success obtained was due not to Mr. Rodier's special method, but to the energetic use of a special form of trap the owner had devised. Mr. Hatton points out that the system has been in use for 15 years and that, so far as Mr. Rodier's own farm is concerned, there is no extermination of rabbits.

In a Table supplied in the Zanzibar Report showing the number of rats trapped, females are more than two to each male. In a similar table in the Trinidad and Tobago Medical Report for 1913, the females constitute 63·4 per cent. of the total rats caught. Polyandry, upon which Rodier depends as inimical to fecundity, may be a normal condition in rats, but would have to be very pronounced before inimical effects could be looked for. But in Zanzibar, side by side with trapping to subserve the Rodier system, poisoning is to be conducted, so that a considerable element of uncertainty as to proportion of the sexes would be introduced. Again, trap-shyness is readily induced amongst rats and, after a certain number of males were freed, it would argue ill for their well-known intelligence if the rats of any locality agreed to being caught a second time. On the whole, in the interests of plague prevention, the writer would prefer to adopt more direct and quicker means than a trial of the Rodier system.

Rewards for Rat Destruction.

Dr. E. A. Chartres suggests with reference to offering rewards for rat destruction "there need be no fear that any West African native will take up rat culture for the sake of the small reward—one penny for each rat." He, of course, speaks from personal knowledge of the people locally concerned; but it certainly would not be safe to generalise that culture of so prolific an animal with prospective rewards at that sum would not tempt trading instincts of some races. At any rate, culture is not the only danger in offering rewards. The writer has known rats to be imported for rewards from beyond the infected areas. This, in a sense, might be of public benefit, but upsets calculations as to diminution of the local rat population; whilst it is hardly satisfactory for the local authority of a town to find it is paying for rats from rural areas. In one area known to the writer, it was ruled that the tails of rats should be produced to claim reward. One man was particularly energetic. He repeatedly brought in neat bundles, each of a dozen tails, by the cartload. These were duly paid for to the extent of 35,000 tails. An inquisitive officer one day opened some of the bundles, and it was then found that a proportion of the tails were made by turning rat skin, with the aid of an adhesive, round piece of appropriately shaped bamboo; one rat besides the normal tail afforded skin enough to make an extra three. Indeed, if a reward is big enough to induce anyone to bring a rat to a depôt, the chances are always that, unless exceptional populations are dealt with, some

speculative methods may be excogitated, and general experience therefore points to the advisability of rat destruction methods being, in the interests of efficiency and economy, controlled entirely by public servants, if the people offer no opposition.

Lieut.-Colonel T. LANE, I.M.S., recommends (*Indian Medical Gazette*, 1914, Aug., p. 322) the following method of both rat and rat-flea destruction :—" I have been trying to simplify the smoking of rats for some time past and I have ultimately invented this little packet or ' plague *pataka*.' It is really a little chemical ' Agenti,' which burns in a space no matter how confined and at the same time burns neem leaves and a little chillis. The method of using it is to set it on fire, insert it into the rat hole and block the hole with mud." Those who would wish to try this method and cannot secure " neem " (*Melia azadirachta*) leaves need not, the writer suggests, hesitate in substituting other forms—although the selection of the " neem " by Lieut.-Colonel LANE is judicious for several reasons.

Control of Rats.

Much effort in plague epidemics is ordinarily made to destroy rats. To control their movements also has its advantages. Previous allusion has been made to the excellent Japanese system of surrounding the first houses infected with plague—or suspected plague—with corrugated iron sunk to a depth preventing escape of rats by burrowing. But obviously there is another phase of the matter. In dealing with houses before they can be mechanically rat-proofed, how is entry of possibly infected rats (after disinfection has been carried out) to be prevented and the spread of rats to be controlled? The writer has used with advantage a method which was communicated to him by the manager of a sugar factory, who had, after great loss by rats, found this measure protective—namely, the use of acid tars fortified by commercial sulphuric acid. After successful experiments kindly conducted for him by Dr. MARSHALL, D.P.H. (now Assistant Health Officer, Rangoon), the writer in 1900 advised the method for general adoption in the Madras Presidency. By its use it undoubtedly is possible, by a single application, to expel rats and to prevent the return of rats into formerly used holes, for a space of time varying from a fortnight to six months. The combination, apparently as a result of efforts of the rats to rid the skin of the irritating sticky mass with the mouth and feet and incidental ingestion, has some feeble killing power, but is not to be relied on for this purpose.

The method of employment is to mix the commercial sulphuric acid and tar (1 to 9) in an earthen vessel *at the time of use*. The mixture evolves slowly, but for a prolonged period, irritating fumes. If this be placed by means of wooden spoons at the entrance of all rat holes in the neighbourhood, what with the difficulty of getting out of the burrows and being attacked within it by fumes, rats have a bad time, and do their best to leave the place. Placed in a house along known rat runs, protection for this particular portion can be gained. The method has proved of great protection to persons compelled to live in houses in the midst of plague infected areas. If a continuous ring of the mixture be placed on the soil, granaries, markets, etc., can be kept free of rats. At the opening of a campaign against rats, it

should prove of value to make a cordon of tar-protected houses completely surrounding an area containing the infected houses, but separated from them by a zone in which poisoning and trapping only is conducted.

Whilst thus writing with absolute confidence as to the efficiency of this method, it is necessary to state where disappointment has been met in use. Firstly, those employing it must not regard it as a rat killing method and judge it accordingly. Secondly, whilst any tar will serve the purpose to some extent, what is required is a tar which will not consolidate in a few hours on being mixed with sulphuric acid ; yet, in the open market, where tar is a waste material after different products have been secured from it, it is not every tar that proves useful. Evidently, what would fulfil requirements best is an acid tar that has not undergone treatment for various products. Dr. H. C. Ross, whom the writer consulted on this point, suggests that " blast furnace tar " is the form that should be sought for. In using this method against rats which burrow in the foundation of houses, it cannot well be traced by what particular hole exit of rats has been attempted ; but in use against field rats, where all entrances and exits of burrows have been treated with the mixture, their objection to remaining in the burrow or passing over the tar mixture is exhibited by their rapidly making new exits for escape.

Tar is in use in New South Wales against rabbits. In this case a wisp of straw is tied round the end of a stick ; this wisp is then dipped in tar, and over the whole a piece of gunny sacking is tied. The plug thus made is thrust into all entrances of holes that can be found. Here it is anticipated the rabbit will attempt to get out of its burrow by tearing through the gunny sacking, with uncomfortable results when the tar is reached. It is possible this might prove useful against rats.

Plague in Ceylon.

The Reports of the Medical Officer of Health for Colombo (Dr. Marshall Phillip) for the weekly periods between the 7th July and the 14th September, show that the predominance of the septicaemic over the bubonic type of plague still exists ; of all cases reported in which a differential diagnosis had been made, there was a total 44 cases of septicaemic and 42 cases of bubonic plague. Careful enquiry is being made as to the relation of rats to human plague ; but the Medical Officer of Health rightly holds that until a full year's experience has been gained and the influence of season upon flea infestation has been ascertained during the ensuing cold weather, it would be premature to arrive at any conclusion.

A point as to which the Tropical Diseases Bureau unfortunately possesses no information is whether the disease has yet extended to the rural areas of Ceylon outside Colombo, and what organisation exists to secure early action in these parts. In the meantime, the facts placed on record by the Medical Officer of Health, Colombo, are of epidemiological interest. Certain of these are quoted verbatim :–

" Fourteen cases were reported as in the previous week. These included two instances of multiple house infection at Forbes Road, where six cases (three in each room) occurred in two rooms within a few yards of each other,

at opposite sides of a narrow alley. Two guinea-pigs were allowed to run loose in each of these rooms, but not a single flea was found upon either of them on the following morning. This differs markedly from the results obtained in similar experiments in India. There was, however, a history of a mumified rat having been found by the occupant upon the roof of one of these houses about 12 days before the occurrence of these cases. . . . . One of the cases occurred at 66, St. James' Street, which is a new area of infection as regards human plague, and also, so far as is known, as regards rat plague since this quarter of the town has been trapped since March with negative results. . . One of the cases occurred on Aug. 18 at 115, Wellgate Road, which is a new centre as regards human plague, but not as regards rat plague, which was discovered there so long ago as 4th June. . . Three cases occurred in previously infected localities, while one occurred at Fisher's Hill, Mutwal, a locality where human plague has not hitherto occurred, although plague amongst the rats was detected there as long ago as 23rd March. This is another of many instances where a long interval has intervened between the first appearance of the disease amongst the rat population and the date when the first human being has been attacked. This taken in conjunction with (a) the relatively very light incidence of the disease here compared with in India both amongst rats and human beings ; (b) the low flea index ; (c) the fact that so far an infected rat flea has not yet been caught ; and (d) the negative results of guinea-pig exposures in infected houses, points to the relatively slight degree of infection here and warrants the comforting hope that unless circumstances materially alter, plague will not assume here the devastating character which it has in many parts of India. . . . The same measures as hitherto were adopted, the hand Clayton being of a great service. Ten minutes pumping into a hole into which a large rat was seen to run resulted in its death, as proved by breaking up the wall and finding the dead body. . . . The method adopted in using the Clayton is to block up all the holes except one in the house, and also in the adjoining house if there is one, and then to pump the fumes into the hole left open. Even so it sometimes happens that the runs extend right through the centre of the wall and open under the tiles. In such cases if a rat is seen attempting to escape up there a man is put on the roof to remove the tiles and block the hole. A considerable number of rats which have thus emerged from undetected holes have been killed by the men who are stationed at various points armed with sticks. As a matter of fact, very few rats which are seen escape."

It is evident that whilst the important position of rats in the epidemiology of plague is fully recognised, the rôle of the infected human being is not being ignored in Ceylon. Apparently, the Indian Plague Investigation Committee have had nothing to say up to date as to the fate of the placenta and discharges in abortions accompanying plague. Information on this point from Ceylon would be of value.

Cholera.

The theory of the connection between cholera and the rise and fall of subsoil water held by Pettenkofer is not likely to be recognised at the present day, unless it can be shown that entrance of the cholera microbe into a water-supply employed for human consumption is thereby brought about. Nevertheless, Stamm's work, an account of which appears in Vol. 3, p. 477, of this *Bulletin*, may ultimately lead to a part justification of that theory. Dr. W. J. Penfold there remarks :—" This work is important in so far as cholera-like vibrios found in water, which do not agglutinate, have been held by various workers to be saprophytic and not genuine cholera vibrios, and if Stamm's work be confirmed the non-agglutinating vibrios ought now to be further investigated, and those that contain the specific agglutinogen may be safely reckoned as specific organisms."

In view of such work, it is possible to revive a theory that was for for some time extant, that the vibrio in subsoil water as found in shallow wells is a debilitated true cholera vibrio capable of change of vigour, as a result of the water becoming charged with various salts from the subsoil. It is possible to show that in certain areas in India subject to two monsoons cholera is under favourable conditions in the greater monsoon—a matter readily explainable by the greater facility for the scattering of the comma bacillus by surface washings. In the writer's experience, if cholera be introduced at any other period, it can be readily suppressed. But an epidemic does not get a real hold of an area till about six weeks after the breaking of a monsoon. The subsoil water begins ordinarily about this period of monsoon prevalence to undergo a marked rise. That it is not earlier is on account of the hard and dry condition of the soil at the end of the hot season resisting penetration, so that, notwithstanding the rainfall at the origin of the monsoon, the water level of shallow wells at first continues to fall. In 1894, the writer came to the conclusion that "the period in which marked mortality from cholera occurs is that immediately following the greatest fall of the subsoil water and heralds a commencing rise."

Before accepting such a theory, it is evident much ground would have to be worked over by the bacteriologist and, in adaptation to a particular locality, the possibility of extension of the drainage cone at the season indicated tapping sources of supply of indubitable cholera bacilli would have to be excluded.

Man as a Cholera Carrier.

In view of the increasingly recognised importance of man as a cholera carrier, the work of STAMM mentioned in the preceding note throws light also upon the reference made by Major GREIG (*Indian Journal of Medical Research*, Vol. 1, p. 75) to the fact that "CRENDIROPOULO is disposed to regard the finding of non-agglutinating vibrios in the stools of persons coming from areas where cholera is epidemic as sufficient evidence to place the 'carrier' of such organisms under suspicion. This view, however, requires confirmation."

In former days it was customary to refer to cholera as endemic in the delta of Bengal, and to regard its appearance beyond that limit as of the nature of invasion. But if the "carrier" doctrine, which Major E. GREIG in his investigation as to the presence of cholera bacilli in the bile duct has done much to forward, be combined with STAMM's doctrine, much light would be thrown upon the epidemiology of cholera.

A side light is thrown upon the issues involved in the Report of the Bureau of Health for the Philippine Islands for 1913, by Dr. V. G. HEISER, Director of Public Health, U.S.A. Public Health Service.* In the Philippines, cholera had been absent from 1911 up to August, 1913. The first man attacked was a resident in a hotel at which it was shown that no guest from a foreign country attacked with cholera

*HEISER (Victor G.) [M.D.]: Report of the Bureau of Health for the Philippine Islands for the short fiscal year from July 1, 1913, to December 31, 1913. Govt. of the Philippine Islands Department of the Interior Bureau of Health. 351 pp. 1914. Manila: Bureau of Printing.

had arrived. From the intestinal contents of this fatal case, the true cholera vibrio was isolated. Further, "the first eight cases occurred in widely separated sections of the city and a most careful investigation failed to trace any connection whatsoever between them." Moreover, for two years previous to this outbreak, although examination of the stools of all steerage passengers from foreign countries had been conducted, no case harbouring the cholera vibrio had been detected amongst them. There is in this history, therefore, reason for suspicion that the interval between 1911 and 1913 had been filled by cholera carriers. In this connection, the history of the reported outbreak of cholera amongst the Austro-Hungarian forces in Europe, after a period of apparent quiescence following the Balkan war, may possibly throw light on the subject.

The importance of examining contacts in cholera was much emphasised in the Philippine epidemic by its being found that "of 72 contacts examined, 40 of them were vibrio carriers of some kind and 29 were true cholera carriers." Dr. HEISER in his Report takes occasion to remark that "these results show in a very striking manner the necessity for proper laboratory facilities if a campaign against cholera is to be intelligently directed."

YAWS.

This disease is very prevalent in the Lower Chindwin District of Upper Burma. The following are extracts from a Report by Civil Assistant Surgeon MAUNG SHWE GÊ, L.M.S. (Calcutta), kindly supplied by Lt.-Col. C. E. WILLIAMS, Sanitary Commissioner for Burma. This Assistant Surgeon is a Burman, and was for a prolonged period on special duty in connection with yaws; he therefore was in a good position to trace the etiology of the disease. He states:—

"Contact does not suffice as a means for the infection. People living in intimate relation with the sufferers do not as a rule contract the disease so long as their skin is intact. Out of 83 cases that have been recorded, the seats of primary infection could be traced in 65 to a pre-existing breach of surface. Cases have also occurred where infection took place through abrasions caused by insect-bites, dog-bites, tatooing, burns and vaccination-scarification. A case has also been known where the disease was acquired through sexual intercourse. A suckling child affected with the lesions on the mouth can also transmit to its mother through abrasions on the nipples and *vice versa*. . . .

"The insanitary surroundings, so far as can be judged, have no direct relation in the production of the disease, except that they form the conditions favourable for the attraction of common house-flies and other insects which have been stated to play a very important part as carriers of the infection. In such poor, dirty, ill-ventilated, infected houses, as are frequently met with in this district, and where swarms of flies are generally present, it is easy to understand to what extent infection may spread. Notwithstanding such manifest danger, infection can at all events be prevented under certain reasonable precautions. Instances have been known where in a family, consisting of several members, one or two members have been attacked while the remainder, by observing hygienic conditions, and by isolating themselves in a separate room though living under the same roof, and by using separate drinking vessels, have been able to avoid infection. . . .

"Women suffering from the affection during the whole or part of the time of their pregnancy have been known to give birth to perfectly healthy children with no taint of the disease; and, in the same way, children born of fathers with a history of previous yaws are generally healthy, and are never found in any way more liable to it. Whether born of parents

afflicted with the disease or born of those free from it, they are equally predisposed to the affection. The youngest child recorded by me to have been attacked with the disease is seven months old (i.e., a period which far exceeds the usual incubation period of the acquired disease). . . .

"It has been asserted in certain affected centres that fowls are occasionally seen attacked with a peculiar disease bearing resemblance to human "Toungoo-nah" (yaws), and such fowls are generally regarded as 'infectious.' . . . Experiments performed on healthy fowls by transplanting the human yaws virus on abrasions, have given negative results. . . .

"A Burmese female was inoculated on the 20th September, 1910, with the secretion obtained from a yaw growth of her daughter suffering from the eruptive stage of the disease, on a site previously pricked by a pin until blood exuded. Three days later, the inoculated site was surrounded by a slight inflammatory areola, and a vesicle at the point of inoculation appeared on the sixth day. The skin then resumed its natural condition with no visible scar. On the 24th October, 1910—that is, a month later—there appeared on the inoculated site a fungating ulcer about the size of a very small pea, the margins of which were seen to be inflamed. There was no constitutional disturbances at that time. I left that place on the 25th. . . . On the 19th of December, 1910, the Sub-Assistant Surgeon of the locality reported, 'The ulcer was perfectly healed—no constitutional symptoms whatever.'"

Smallpox.

The Relationship of Variola and Vaccinia.

The United States Army Board for the study of Tropical Diseases as they exist in the Philippine Islands, the members of which are Major P. M. Ashburn, Captain E. B. Vedder and Lieut. E. R. Gentry, of the U.S.A. Medical Corps, has issued a Report on "Some Experiments on the Inoculation of Monkeys with Variola Pox" (*Philippine Journal of Science*, Section B. Tropical Medicine, 1913, Vol. 8, No. 1 pp. 17–28, and No. 6, pp. 429-441). As a result of numerous and carefully conducted experiments they furnish the following "Comments" on the results secured by them:—"The case of monkey 5, although of little value standing alone, is certainly susceptible of being cited as an instance of *variola sine exanthemate*, as an instance of separation of the elements of smallpox virus (the pock-producing or 'B' part having acted on the monkey in October; the toxaemia-producing, pyrogenic, or 'A' element in December), and as proof that vaccination protects against the pock-marking element of smallpox rather, or to a greater degree, than against the whole disease. We feel justified in re-stating our hypothesis that smallpox is due to a dual and divisible virus,* one part of which is the cause of vaccinia and the pock stage of smallpox, the other part being necessary for the production of the highly contagious, febrile, general disease with an initial stage and preliminary rashes."

* In a paper read before the Calcutta Medical Society, Prof. W. J. Simpson, C.M.G., stated his belief in the dual nature of small-pox virus (*Indian Med. Gaz.*, 1892, pp. 148–157).

Some side light on this subject is afforded by experiments made by the writer (Colonel W. G. KING) in 1891 and in the first quarter of 1892, which are referred to at page 1376 of the *British Medical Journal* of November 7th, 1896, as follows :—

"It is acknowledged, from causes not yet explained, that it is only in a small percentage of cases that inoculation of the calf with smallpox virus is followed by a crop of vesicles. Nevertheless, in certain instances, whilst no local eruption is found, constitutional disturbance occurs, and is exhibited by fever and various skin conditions that I need not here detail. If an animal that has undergone this modified form of variolation be inoculated with animal vaccine, there result vesicles abnormally slow in their progress, but of perfectly typical character. Lymph so gained, when transmitted, is found to be fully regenerated, and is highly active. In these two facts—which I verified repeatedly—lies, I think, the possibility of some explanation of the true nature of vaccine at the hands of the bacteriologist."

Irrespective of the practical utility of the method in securing rejuvenation of animal vaccine, as stated in the above quotation, the American experimenters would seem to concur in the belief there expressed that along the line indicated of a dual character of a virus producing on the one hand variolation without eruption and on the other vesiculation, is the most promising route of investigation for the bacteriologist as to the character of variola and vaccinia.

The obtaining of smallpox virus and calves is frequently not the matter of difficulty in the tropics that is the case in Great Britain ; and the writer suggests that in the presence of the numerous scientifically trained workers in India and our Colonies, the endeavour to solve the problem of the relationship of vaccinia and variola, which the Americans have thus ably inaugurated, should be followed by further efforts.

Strains of Vaccine.

In estimating the success rates of vaccine, the character of the vesicles and local and constitutional reaction are points that naturally arrest attention. The fact that a strain of vaccine is still capable of producing vesiculation, however, cannot be regarded as the sole necessary proof of its potency ; that much might be accomplished by a decidedly degenerate vaccine. Indeed, certain experiments by the writer have led him to believe that vesicular eruptions other than cowpox can be implanted by inoculation on the calf, and will assume by transfer from calf to calf considerable local similitude to true vaccine but yet be distinguishable. These experiments were conducted so as to exclude contamination with true vaccine.

The power of protection as represented by vigour of stock, or a strain of a stock, can only be answered by lapse of time in the absence of the test of smallpox inoculation. But in dealing with preserved vaccine, it is probable that another factor comes into play. The vitality of a degenerate strain more readily succumbs to vicissitudes of temperature and prolonged storage than one in a state of vigour. It is likely, but still unproved, that coincidently with this loss of resistance there occurs a degradation of specific power as vaccine in inducing immunity. The question of maintenance of vigour of animal vaccine stock lymph, therefore, is the most important duty with which officers in charge of vaccine institutes are confronted. The Public Health Report for 1913, Zanzibar Protectorate (page 23), thus alludes to the subject :—

"From the subjoined table it will be seen that of the results we know of only three in five were successfully vaccinated, whereas in 1912 the failures only amounted to one in 30. A possible explanation of the large number of failures is that a very high proportion of the people vaccinated nowadays have already been vaccinated once before, but I think besides that the strains of lymph we were using were not as good as in former years."

Duration of Vitality of Preserved Lymph.

*Dr. RINGENBACH reports that on a medical tour between Brazzaville and the coast, owing to the fact that there was no vaccine at Brazzaville, he took with him vaccine in powder supplied by the Belgian doctors at Leopoldville. This had been despatched from Brussels five months before and had been four months in the Colony lying in a drawer in the laboratory. It was mixed with water and glycerin before use. 380 vaccinations were done, with 32 per cent. of successes. He recalls the results obtained by JOYEUX in French Guinea and by SOREL and ARLO on the Ivory Coast with dry vaccine; a sample in the latter case after three weeks in a mailbag on the head of a native gave 70 per cent. of successes.

The following is an extract from the Annual Report, Medical Department, Colony of the Gambia, for 1913 (page 10):—

"Dr. J. A. HARLEY, on tour with His Excellency the Governor and company, vaccinated in all the towns visited, from December, 1912, to May, 1913, when the heat was so great that lymph became inactive. The lanolinated lymph was principally used in the Protectorate, and at Bathurst the glycerinated lymph was used, and the results were favourable."

The results of the two vaccines are not differentiated, but the statement that glycerinated material was used in Bathurst and the lanolinated in the Protectorate by an officer on tour is noteworthy, as an exemplification of selection in view of the respective duration of vitality of the two varieties under tropical conditions. The matter is also attracting attention in the Philippine Islands, where Dr. HEISER, in the Annual Report of the Bureau of Health for 1913 (p. 477), states:—"In this climate the ordinary glycerinized vaccine will not always remain potent for a greater period than one week at ordinary temperature." Consequently experiments are now being conducted in the Islands with dried vaccine.

In a locality where ice can be procured, or the vaccine can be stored at room temperature and utilised within a few days, glycerinized lymph has, the writer believes, a sphere of usefulness; but under circumstances of travel or prolonged transport in the tropics the choice is likely to be limited to either dried or lanolinated vaccine. Good instances of survival of vitality of dried vaccine are given in the preceding paragraphs.

The following extract from a paper, "The Cultivation and Preservation of Animal Vaccine under Tropical Conditions," by the writer, read at the Berlin Congress (1912) of the Royal Institute of Public

* Tournée Médicale effectuée de Brazzaville à Pointe-Noire (Moyen-Congo et Gabon) en Juin et Juillet, 1912.—*Ann. d'Hyg. et de Med. Colon.*, 1914. Apr.–May–June. Vol. 17. No. 2, p. 371.

Health, may afford a useful estimate of the relative value under tropical conditions of lanolinated vaccine :—

" Its duration of vitality must necessarily vary with the degree of care with which it has been prepared, both in regard to the lanoline meeting requirements of purity* and the bacterial cleanliness of manufacture. Thus, in the Madras Presidency, the scab of the vesicle is entirely rejected. Assuming, however, that only specimens so prepared can bear excessive exposure during transit, the following examples of duration of activity in the tropics may be of interest :—

" Surgeon-Major Peacocke, when Deputy Sanitary Commissioner for Bombay, reported (1891) that with lanoline vaccine sent by me from Bangalore he had established lymph in certain places in Scinde where the temperature in the shade was from 116° to 119° F. Col. Hendley, C.I.E. (then Civil Surgeon at Peshawar), in experimenting on the samples forwarded from Madras of from 17 to 97 days old, obtained a total average vaccination success in 158 cases of 95·5 per cent. and an insertion success of 83·05 per cent. ; at 97 days old, the preparation gave but one failure in 16 cases performed. Col. Thomson, C.I.E., when a member of the Leprosy Commission, received at Madras on December 13, 1890, an ordinary part of that day's issue. During December, 1890, and January, 1891, the paste travelled with him through Madras, Burma and Bengal ; in February and March it remained in Bengal and the N.W. Provinces. At the end of March it was sent to Simla. It was tested by him with success at various times upon children and calves, and with the last remaining portion, on June 11th, 1891, a calf was successfully inoculated.

" On the 24th July, 1891, I ceased making lanoline-vaccine for the Government of Madras in Bangalore. There was an interval from that time to February 3, 1892, when its preparation was resumed under Dr. Palpu (lately Deputy Sanitary Commissioner) on behalf of the Mysore Government. The stock with which these operations were started was from a specimen of lanoline-vaccine made on the 19th July, 1891, which had been retained in my possession in the interval at room temperature in Madras and in Burma. Encouraged by the success of my retained specimen of the 19th July, 1891, I sent Dr. Palpu a specimen made on the 22nd July, 1891. It was reported by him successful on the 22nd May, 1892. As an instance of a long road journey I may state that under Col. Roberts, I.M.S., lanoline vaccine sent from Bangalore enabled him in the early days of occupation by the British to secure a vaccine at Gilghit, after repeated importations of glycerinized specimens had failed. In Kabul the same difficulty had been experienced. Miss (Dr.) Hamilton, for some time physician to the Ameer of Afghanistan, reported that she established a supply of vaccine for that territory by lanoline-vaccine imported from Bangalore. It was nearly a month (October) on the journey, and was not used till about a fortnight after its arrival. In reply to my queries recently, she reported that the first calf inoculated ' was the picture of what a vaccinated calf's abdomen should be.' A photograph taken by her of subsequent ' removes ' shows that the vaccine had fully retained its vigour under her care. Voigt has stated in the *Archiv. fur Schiffs- und Tropen Hygiene* of December, 1911, that the advantage of lanoline over glycerine rests with its better resistance to sun heat. He quotes Dr. Ziemann as writing from Dualla that he had carried with him lanolinated vaccine through the whole country from Dualla to Garua, a two months' journey, where, after being stored an additional 36 days, he got 70 per cent. case success.

" In 1908, Major Patton, I.M.S., placed lanoline-vaccine in a Hearson's incubator, so as to retain it at a temperature of 76° F. for 81 days. At the end of that time it gave 100 per cent. case success and 50 per cent. insertion success. In a Note in his Report ending 31st March, 1908–'09, Major Gibson, the Director of the King Institute, Madras, states :—' It is important to remark that glycerinized lymph is much more sensitive to high temperature than is lanolinated lymph.' Major Hutchinson,

* It must be anhydrous, neutral, and free of glycerine, fats and chlorine.

who has done much to improve vaccination in the Bombay Presidency, and is himself an advocate for glycerine, states that 'lanoline is undoubtedly better than glycerine as a preservative,' but values the former on account of its reputed bactericidal power."

Protection of Vaccine from Heat during Transit.

Dr. Rodenwaldt, * writing from Togoland, describes a method of preserving vaccine lymph in the tropics which has rendered him good service, the idea being originally suggested to him by the perusal of an article written by a French colonial medical practitioner (reference not given).

The arrangement is as follows. A piece of growing banana stem is taken, about sixteen inches in length and having an external diameter at its thinner end of about six inches. By means of a suitable knife the inner leaf-stalks are scooped out so as to leave a tube, with a cavity measuring about two inches across, and having walls about two inches thick. It is the property of growing banana stem that it maintains its internal temperature at a constant figure of 23–25° C., whatever the external temperature may be, owing to vital processes, so that if the cavity of such a piece of hollowed-out stem is filled with tubes containing lymph, the vaccine will retain its activity for a full month, provided that the piece of stem remains living for that length of time. The ends of the tube should be plugged with two thick pieces of stem cut to shape. Such a receptacle filled with tubes containing lymph can be safely sent by native messengers on foot for a journey of three or four days duration, without the lymph losing its activity from the heat of the sun.

As a further improvement on this arrangement, the author recommends that, when the medical man himself goes on a vaccinating expedition, he should once a day spray the interior of the receptacle with its contained tubes with ethyl chloride, so as to reduce the temperature of the interior of the cavity to 6° C., the result being to keep the average temperature of the cavity well below the limit of 25°. By taking this precaution the author was once able to maintain a supply of vaccine lymph in full activity for a period of eleven days when on a vaccinating tour. The piece of banana stem used retained its vitality for the whole of this period. At every halt the temperature of the cavity was taken with a thermometer and was found never to exceed 24°. The spray was then used as described and the tube once more closed †.

In the preceding note ingenious methods of protecting preserved vaccine during transport in the tropics are explained. A mode much used by Voigt may be added to these, viz., the placing of tubes within the interior of potatoes.

* Ueber ein Behelfsmittel zur Konservierung und Versendung von Pockenlymphe in der Tropen. [A Method for preserving and conveying Vaccine Lymph in the Tropics.] *Arch f. Schiffs- u. Trop.-Hyg.*, 1914. June. Vol. 18. No. 12. pp. 408-414.

† Summarised by Dr. Nias.

Putting aside the possibility of vaccine dispatched by steamer being stored within range of heat of boilers, the writer has always had more dread of the treatment which vaccine may undergo after delivery to a vaccinator than even during transit, involving the carriage of packages as headloads in tropical heat. Hence, he has always required a separate arrangement for protection during transit, and for storage and transport after delivery. Probably the method for transit to tropical colonies which the Lister Institute has employed from time to time, viz., of using thermo-flasks, is a sound one. But when only crude apparatus is available, a small wooden box with a wooden bracket, so as to keep the vaccine in the centre, and surrounding it with a loose packing of cotton wool has proved all that is necessary. Instead of a box, a section of large female bamboo serves the purpose well; and, in late years, an ordinary paper box filled with cotton wool has been freely employed. In the hands of a vaccinator the temptation to be guarded against is the removal of a tube of vaccine from the transit packet, placing it unprotected in the pocket and marching many hours in the sun to the next station on his programme. To meet such requirements the writer devised a box the interior of which was filled with sawdust, so as not to communicate with the external air, and closed in, yet leaving central spaces for receipt of the tubes; a lid was then superimposed. The whole exterior was covered with thick felt. The vaccinator was required to retain the tube of vaccine as soon as received in this box, and to employ it during progress from village to village. The necessity for avoiding exposure of the vaccine to the sun glare whilst in the act of operating was insisted upon. This arrangement was apparently of utility. A later development of these principles in Burma (in consultation with Major O'Gorman Lalor, I.M,S., Deputy Superintendent of Vaccination in that Province) was the use of a tube of asbestos cloth surrounded by cotton silicate—the whole placed within a wooden or bamboo tube.

Infantile Vaccination.

Dr. C. Killick Millard, in the *British Medical Journal* of 22nd March 1913 (p. 637) gives the opinion that it is probable that "in spite of increasing neglect of vaccination, smallpox (in this country) will ere long become virtually extinct" and, therefore, argues that "vaccination as a State system, for the compulsory vaccination of infants, is no longer necessary." He believes that, under a sound sanitary system, protection by vaccination is supererogatory. As he particularly specifies that his arguments are applicable solely to Great Britain, it would be beyond our scope to discuss the pros and cons of the question. But in the tropics, where sanitation does not yet work with the precision he concedes is necessary, it is worth while contrasting his findings with results in localities where infantile vaccination is imperfectly conducted at a late period, and those where a better grade is secured by belated but yet earlier vaccination. In areas in India, even where vaccination is compulsory, infants are not vaccinated until they are six months of age, although in the Madras Presidency within Municipalities power is given to vaccinate infants known to be exposed to smallpox infection at any age. It is, however, only in

exceptional rural localities that any compulsory ruling exists. In consequence the protection of infants under one year is poor even in Municipalities, but is better than in rural areas where vaccination is liable to be delayed in a large proportion of cases till the child is over five years of age. Thus in Municipalities of the Madras Presidency in the decade ending 1902, 2·7 per mille of infants under one year of age died of smallpox, but in rural areas the proportion for this age was 8 per mille.

The following facts as to children below ten years of age examined haphazard as found in the streets during inspection of certain towns are significant of the beneficent influence of vaccination, even under the belated conditions stated :—

Children examined without selection in streets.

Towns.	Vaccinated. Per cent.	Not vaccinated. Per cent.	Vaccinated, but marked with smallpox. Per cent.	Not vaccinated, but marked with smallpox. Per cent.	Remarks.
A.	56	44	Nil.	36·4	Compulsion had been but recently introduced in the towns concerned.
B.	33·3	66·7	Nil.	54·5	
C.	44·3	45·7	15·8	93·7	Children are much exposed to infection by attending religious ceremonies in honour of the goddess of smallpox.
D.	73·9	26·1	Nil.	57·1	
E.	42·5	57·5	17·7	74·0	
F.	92·8	7·2	2·6	100	
G.	70	30	2·6	81·6	

Vaccine Success Rate after Smallpox.

The following is an extract from the Annual Medical Report, Nyasaland Protectorate, for 1913 :—

"As stated in the last report, the lanolinated lymph which is supplied by the Lister Institute of Preventive Medicine continues to give every satisfaction. A test inspection of natives, which was made during the year in a large number of districts, with a view to ascertaining what proportion was vaccinated, yielded results which varied from 60 to 90 per cent. in the different districts. In regard to the question as to how long vaccination in the tropics confers immunity against smallpox, it can only be said that the subject is a most difficult one on which to express an opinion. Natives who have recently been vaccinated have sometimes contracted smallpox, and there are instances in which reaction to vaccination has been obtained in natives who have previously suffered from the disease."

The evidence required on the point raised by Dr. Hearsey, Principal Medical Officer, is to some extent met by the following results of vaccination work by the writer in India and Burma :—

In the Indian Army in 1891, it was not customary to vaccinate native soldiers on enlistment, if they presented well marked signs of previous attacks of smallpox. Of 56 men so marked 75 per cent. responded to vaccination.

Amongst the Vizagapatam hill tribes, Chins, Burmese and Chinese, who had been inoculated with smallpox virus by native methods, it was found that in 880 the operation had been performed when under fifteen years of age; of these, 5·6 per cent. admitted having been attacked with smallpox during adult life. Of 976 inoculated persons, only 94 had been inoculated when above fifteen years of age; of these, 3·2 per cent. had been attacked during subsequent years with natural smallpox. 313 persons who had been inoculated when below fifteen years of age and were vaccinated in adult life gave a success rate of 80·3 per cent. In the 94 who had been inoculated when above fifteen years of age, the vaccination success rate was 81·8 per cent. Necessarily no statistics of the number of persons who died when attacked synchronously with the inoculated subjects who survived and were examined, could be obtained. However, evidence on this point is available from a Report on an effort to revive inoculation by some inhabitants of a rural area on the frontier of the Madras Presidency in 1906, written by Certificated Sanitary Inspector P. Annakutti Aiyangar. According to this account, the mortality amongst those inoculated varied from 20 to 40 per cent. (*Proceedings of the Sanitary Commissioner with the Government of Madras* for the first Quarter of 1906).

Pellagra.

Investigations in America.

Goldberger*, the Surgeon in charge of Pellagra Investigation, U.S.A., thus states results of work fulfilled on the subject of pellagra up to September 4th of this year:—"The inference may therefore be safely drawn that pellagra is not an infection, but that it is a disease essentially of dietary origin; that it is caused in some way as for example, by the absence from the diet of essential vitamines; or possibly, as is suggested by Meyer and Voegtlin's work by the presence in the vegetable food components of excessive amounts of a poison such as soluble aluminium salts." At the same time, he lays down that this opinion should not be regarded as final "without some practical test or demonstration of the corollary, namely, that no pellagra develops in those who consume a mixed well balanced diet."

As bearing on the grouping of pellagra as a diet deficiency disease, W. F. Lorenz†, Special Expert, U.S.A. Public Health Service, made the experiment of excessive feeding in the case of 27 acute cases of this disease for a period of eight weeks. "Of these 7 died, 3 were unchanged, 13 had improved and 4 were designated as recoveries. In these latter, all visible evidence of pellagra had disappeared, and the mental condition had cleared up entirely." As the experience is limited, he suggests that conclusions are not yet warranted.

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* Goldberger (Jas.). The cause and Prevention of Pellagra.—*U.S. Public Health Reps.*, 1914. Sept. 11. Vol. 29. No. 37. pp. 2354–2357.

† Lorenz (W. F.). The Treatment of Pellagra. Clinical Notes on Pellagrins receiving an excessive Diet.—*U.S. Public Health Reps.*, 1914. Sept. 11. Vol. 29. No. 37. pp. 2357–2360.

Nyasaland.

The etiology of this disease as it occurs in the Central Prison, Zomba, Nyasaland, is discussed by Dr. Hugh S. STANNUS, both in relation to diet and the Sambon theory of "protozoal infection of Simuliidae." In regard to the latter theory, he states that the Simuliidae are found in large numbers in Zomba, and that the prisoners are particularly liable to be bitten by them. He leaves this point open, however, by asserting "there is reason to believe that no cases are seen when Simuliidae are not found, though of course cases are not found wherever Simuliidae are present." He shows that maize cannot be inculpated, as it is not used; the grain given to prisoners being rice, grown in the country and delivered with the pericarp, in part, still evident. Before delivery, the rice undergoes prolonged transport in plaited grass bags, and, in 1911 and 1912–13, ran the risk of damage during the rainy season, although apparently in a correct physical condition when judged by the eye. It is stored in galvanised bins, and as these approach depletion, it is found that the rice "contains most of the dust and any fragments and spores of moulds." On this aspect of the subject he concludes:—

"I have dealt with the subject of rice at some length, as there are some significant facts in this connection. It would appear quite possible that the unsupplemented rice diet may be so low in some particular food value as to be the cause of pellagra—as is the polished rice of beriberi. Or, again, the damaged "grain" theory seems to receive possibly some support. Cases of pellagra seen among the general population might be due to want of food of proper nutritional value owing to the famine, or to the eating of damaged food stuffs in the recent times of want."

When, in the light of this declaration, the nature of the ration allowed the prisoners is enquired into, it is found that it consists solely of 1½ lbs. rice per diem, *plus* salt. "They are able in a very small way to supplement this diet by buying green foods with the salt. In normal seasons fish or meat is supplied once a fortnight." Whether or not this diet is responsible for pellagra must be left open to question as Dr. STANNUS desires, but it would seem more wonderful that the prisoners did not present indubitable signs of scurvy and general inanition on such a diet than that they should get pellagra. Obviously, the standardizing of prisoners' diet by the Government of Nyasaland, so as to ensure they possess a due proportion of proteids and anti-scorbutics, is desirable.

Dr. STANNUS places great stress upon a characteristic symptom of the pellagra observed by him, namely, at the angle of the mouth a "a sodden and thickened epithelium with cracks which appear white on the black skin." It affects not only the skin, but is prolonged across the muco-cutaneous junction a little way into the mouth." This symptom is accompanied by a creamy condition of the tongue followed by exfoliation, so as to leave "a bright shiny surface devoid of visible papillae." Whilst not doubting that this condition of the mouth and tongue is characteristic of the pellagra found in Nyasaland, it certainly is not diagnostic; as both this state of tongue and angle of mouth are not infrequently sequels in a native of India partaking of salted fish on the verge of decomposition. It is noteworthy that these prisoners, to supplement their defective diet, were allowed an unstated amount of *fish* or meat once a fortnight!

Zanzibar.

Dr. Stannus has suggested that pellagra exists in Zanzibar, and supports the opinion by reference to the existence of Simuliidae. The Health Officer, Zanzibar, in calling attention to this opinion asserts that Dr. Aders, the Government Entomologist, declares that, "so far as his entomological research has gone, none of that family of Diptera have ever been found here. . . . Personally I am not prepared to admit that pellagra exists in Zanzibar or Pemba."

Helminthiasis.

Ankylostomiasis.

Dr. P. C. Conran, in the Nyasaland Protectorate Annual Medical Report for 1913, makes the following statement:—"It is of interest to note that Looss states that a pure vegetable diet produces a less favourable medium for ankylostomiasis ova than a mixed diet." . . . Now, fish and fowl are more abundant near the lake, where ankylostomiasis is rife, than in the hills, where it is comparatively rare." In the matter of prevention, he urges the importance of night soil conservancy by the use of simple forms of latrines.

W. D. Neish, Kingston, Jamaica, states* that in his laboratory he has found "that ova and small ankylostomes were destroyed by normal saline solution. This also accounts for the absence of hookworm disease on two estates in Portland, where the labourers live in barracks on the seashore." He, consequently, suggests sprinkling periodically a solution from "rock salt" over portions of ground likely to have been defiled with night soil.

In some localities any form of salt is expensive. Here the writer would suggest the use of the "Lucal Heater," which, worked by petroleum under air pressure, affords a blue flame emitting heat sufficient to melt copper wire rapidly. The burner can be fixed to a long flexible metal tube, and large surfaces of ground can by its means be rapidly exposed to enormous heat.

Bilharziasis.

Dr. Carneux states, in the Bacteriological Division of the Zanzibar Report for 1913, that he had the opportunity of keeping faeces derived from a case of rectal bilharziasis, on two occasions, sufficiently long to exhibit liquefaction following commencing decomposition. No water was added in making a microscopic examination, "yet miracidia were found that had hatched out of the ova." He is therefore inclined to support the belief of Professor Looss that "in all probability the mode of entry into the human body is the same as in anchylostomiasis."

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* *Report of the Advisory Committee for the Tropical Diseases Research Fund*, 1913, p. 189.

Fixed Diet.

Fixed diets have the risk of monotony, and the still greater risk, in the case of jails, of their being so calculated in the interests of economy (in respect to subjects from whom hard labour is demanded) that a very slight error in quantity or quality suffices to produce quickly grave alteration in nutrition. Hence, each detail of nutrition and condition of prisoners is an anxious matter to officers in charge. Nevertheless, at times flaws in methods occur which tax not only medical knowledge but the detective abilities of a Sherlock Holmes. Thus, the Rangoon Central Jail (average strength 2,306), according to the Report of Prison Administration in Burma for 1912, by Lt.-Colonel Bell, C.I.E., gave a curious illustration of some temporary defect in diet producing a disease allied clinically to scurvy. This is the description given of it by Captain Pridham, I.M.S., Superintendent of the Jail :—

"The type of the disease was unusual, chiefly differing from the text-book description in the following particulars :—It was almost invariably accompanied by fever (scurvy being apyretic). The brawny swellings were almost entirely confined to the calf and thigh. The coagulability of the blood (tested by the Chemical Examiner, Captain Owens, who kindly investigated the point) was normal. Issues of fresh vegetables from the jail garden, fresh milk, meat and fish did little to improve matters, while issues of sweet potatoes had an early beneficial influence in most cases."

The Superintendent further states :—"The food has been excellent, in my opinion, both in quality and quantity. The outbreak of scurvy, in the face of a regular supply of good fresh vegetables, is surprising and, at present, unexplained." . . . "It is a fact, however, that issues of sweet potatoes bought in the bazaar were decidedly effective in eradicating the disease."

The normal diet, which long experience of its use in the Burma jails shows is ample, is as follows :—"Rice, 24 oz. (husked and winnowed) ; dâl or pagees (beans), 4 oz. ; vegetables (without stalks or refuse), 10 oz. ; oil (vegetable oil), $\frac{1}{2}$ oz. ; condiments, $\frac{1}{8}$ oz. ; gnapi (fish paste), $\frac{1}{2}$ oz. ; salt, $\frac{1}{4}$ oz.

Much less is known about the antiscorbutic power of various vegetables grown in the tropics than is desirable, and it is obvious that there is here scope for original work. It need not, for example, be taken for granted from the above evidence that sweet potatoes are an antiscorbutic of indubitable quality. In jails in India depending upon their own gardens for vegetables, there is often a tendency to trust largely to of the gourd tribe which, although readily giving the desired weight of vegetable matter, have an undesirable percentage of water in their composition. Major E. D. W. Greig, I.M.S., in his review of the position of the vitamine question in the *Indian Medical Gazette* of April, 1913, mentions two facts that may have a bearing on the case. Quoting Cooper, he shows that beef and rice are inefficient in loss of weight prevention and as anti-neuritics. Although the diet above quoted of the Burma jails shows that no meat is issued, presumably for special reasons, beef was issued during the period of outbreak of the disease in Rangoon and, possibly, replaced the beans upon which reliance is largely placed for the proteids of the fixed diet. Polished rice may be excluded from consideration, as the "husked form" only is used. But in large jails in Burma steam cooking is employed and, although the condition of the average prisoner population of over 16,000 demonstrates clearly this has no

harmful effect on the general health*, it may happen that a special jail garden or other conditions may restrict the variety of vegetables, and the influence of heat might be exhibited on the particular vegetable in frequent use. The steam for cooking is not under pressure—unless slight from the weight of covers of the food boilers ; but there is possibly room for deterioration of anti-scorbutic powers, as shown in the the following statement by Major Greig :—" Gryns has suggested that food stuffs when heated to 120° C. lose their protective power as regard beri-beri. Cabbage heated to 110° C. loses completely its antiscorbutic power, and the juice of the cabbage was inactivated at 60° C. to 70° C., showing, as Axel Holst points out, that the antiscorbutic capacity is much more " thermo-labile " if the juice is pressed out of the leaves than when it is enclosed in the intact cells." In this connection, it may be recalled that in the American Civil War scurvy was arrested by issue, in barrels, of pickled onions and cabbage, and of slices of *raw* potatoes preserved in molasses.

In his Report on the Jails of the Central Provinces for 1913, Lt.-Colonel Lane, I.M.S., makes the following remarks on prison scurvy in which the influence of heat is adverted to :—

" In cooking vegetables, it is well known that the salts are boiled out and that pressed vegetables are no use in scurvy. Besides that loss, I am of opinion that the salts in cooking are changed, and lose that active (nascent) property to a large extent, which may be the reason of lime juice being so effective in scurvy, and possibly also eggflip and raw meat juice as pick-me-ups. I have, therefore, ordered that the common country mango chutney, limes, the green seedpods of radishes, cucumbers, tomatoes, small onions, small radishes, according to the season and the opportunities at each jail, are to be given raw to prisoners, preferably at the early morning meal."

This view of the matter seems to the writer to be of an extreme nature and likely to lead to an aggravation of various disease conditions in jails where night-soil is used freely in cultivation, but the result should be interesting sanitarily.

Influence of Public Water-Supplies in Indian Towns.

Major S. A. Harriss, I.M.S., Sanitary Commissioner for the United Provinces, in a paper read before the Second All-India Sanitary Conference at Madras, showed how very largely the maximum influence of public water supplies which might be expected on cholera prevalence in urban areas has been delayed by such defects as intermittence of supply, and the use of other incompletely protected sources by the inhabitants. Nevertheless, he was able to prove that the number of years in which the cholera death rate rose above 1 per mille was reduced by the filtered water-supply to about half in Dehra Dun, Meerut, Benares, Lucknow and Naini Tal, and in Musoorie, Agra and Cawnpore to *nil.*

The Government of Madras, in their Review of their Sanitary Commissioner's Report for 1913, state :—

" From Statement XIII., appended to the Sanitary Commissioner's Report, it appears that in twelve municipal towns in which a protected water supply has been in existence for more than five years the number of deaths from fever during the last five years was, on an average, 15·5

* Fink (Lawrence G.) (Burma). *Trans. xviith International Congress of Medicine,* London, 1913. Sect. xxi. Trop. Med. & Hyg. Part 2. p. 117.

per cent. of the total mortality, against 25·0 during the five years previous to the date of the introduction of the water supply, while the number of deaths from cholera was 5·7 per cent. in the later as against 9·8 in the earlier period."

Here, a striking feature in the reduction of mortality from "fevers" is exhibited, notwithstanding in most instances the absence of accompanying drainage. Under similar circumstances, according to a former Sanitary Commissioner of the Punjab, the introduction of water supplies resulted in an aggravation of malaria in that Province. This was probably the case; but, in the instance of Madras towns, a decline of "fevers" after the introduction of water supplies has been amply demonstrated. The important question remains open—what is the nature of this fever which thus declines in the presence of protected water supplies? Granted that a certain amount may be ascribed to typhoid or paratyphoid, their existence amongst the native population would not seem to be of an extent disclosed by these figures. As suggested some years back by the writer, the question is well worthy of special research. Major FRY'S "First Report on Malaria in Bengal" shows that typhoid is a serious factor both in urban and rural areas in that Presidency.

ANTI-MOSQUITO MEASURES.

Flight of Mosquitoes.

In deciding the extent of drainage or other anti-mosquito operations in inhabited areas, the most important factor in determining the cost of permanent engineering works is the distance of pools beyond the treated area favourable for mosquito propagation. This being so, it is evident that a much neglected point of research is the distance of flight of the mosquito. Before Ross cleared the air of "miasm" in favour of mosquitoes, the influence of soils afflicted with surplus moisture was fully recognised and distances were fixed which, judged by data now available, did not err on the side of moderation.

In Italy rulings on this point with special reference to irrigation have varied greatly from 1575 up to date; the tendency being to reduction of zones as experience accumulated. Rulings in force subsequent to the incrimination of the mosquito are reproduced elsewhere in this number. CHRISTOPHERS and JAMES suggested half a mile as probably a distance not often exceeded by anopheles; later, at Mian Mir, the former estimated a flight at 1,320 yards. Major GOOD, I.M.S. when in charge of the Ruby Mines area in Burma, gave good reason for thinking that a flight of three quarters of a mile may be indulged in. WATSON showed the influences of various distance from jungle infested with mosquitoes up to 1,000 yards (*vide* this *Bulletin*, Vol. 4, p. 192). DEMPSTER, of splenic index fame, considered a dry zone of one mile essential for protection against malaria. In the Panama Canal Zone a 400 yard protected area embracing 200 yards subsoil drained, *plus* an area cleared of jungle with oil treated pools within a further 200 yards, was typical of measures employed. But, according to the Isthmian Canal Report for January 1913, the *Anopheles tarsimaculata* and *albimanus* not only can travel a mile but can do so "apparently at right angles to the prevailing wind."

To be able to identify a mosquito found in a dwelling as one bred in a pool at a known distance, would go towards settling financial qualms as to anti-malarial works. On the Panama Canal this has been aided by dyeing mosquitoes—presumably with a colour not an aniline product. The facts are thus brought to notice :—

" It would appear, then, that the *Anopheles albimanus* and *tarsimaculata* in the area mentioned ovideposit in water that is decidedly brackish, so that adults fly eastward for long distances between 6 and 8 o'clock. There is relatively little travel after that hour. Adult anopheles were stained with dye and liberated at the swamp. Subsequently, some of them were collected on the opposite side of the river, at the locks and in houses 4,700 ft. from the liberating station. It should be stated that the Anopheles flight was decidedly marked and was easily noted by half-a-dozen witnesses, when their attention had been drawn to it. Even so, not one person in areas strictly infested did note the flight until shown the way to observe it.

It is very interesting to note that there is apparently no large or marked return flight to the swamp from east to west. It may be that such occurs, but that it is of a different nature from the direct flight and not yet understood. The most surprising part of the observations made was that the flight did not extend very far beyond the inhabited area where the employés live. It was expected that with thousands of Anopheles adults travelling from the swamp to the settlement each night some would go well beyond the settlement in the apparently direct line of flight. Such extension did not occur."

In the Report of the Isthmian Canal Commission for February, 1913, the subject was further referred to as follows :—" Several stained Anopheles were found near the breeding area more than two weeks after they had been stained at that locality. It is of interest to note that some of the marked specimens were retaken more than 6,000 feet from the point where they were liberated."

Anopheles Daylight Raid.

J. Prince, C.E., Chief Sanitary Inspector, Isthmian Canal in the *Journal of the American Medical Association* of December 20th, 1908, in dealing with mosquito destruction in the tropics stated :—" We have not yet any cases on record showing that Anopheles will bite a person exposed to the direct rays of the sun . . . . it will bite voluntarily at any hour of the daytime but does so mostly indoors, or out of the direct rays of the sun." According to the *Report of the Department of the Isthmian Canal Commission* for January, 1913, the Anopheles have proved there are exceptions to the rule. It is there stated, " During eight years of sanitary work on the zone only one case was recorded where Anopheles have bitten a person standing in the full rays of the sun. That occurred at 8 a.m." But, in a place described as possessing pools containing from 30 to 75 per cent. of sea water, the larvae were found at unusual density. " The *A. albimanus* and the *A. tarsimaculata* bit quite freely there in the full sunlight at all hours of the day. . . . . Culex larvae were comparatively scarce."

Dr. W. D. Neish, District Medical Officer, Spanish Town, Jamaica, quotes Professor Smith of New York as holding that the *punctipennis* (the *A. crucians* of Wied.) is a " daylight Anopheles and is a great nuisance to travellers on the Mississippi." Neish states that " specimens have been found in Jamaica at Montego Bay, Blayre River and Annotto Bay. This mosquito has been proved to carry malaria." (Appendix VI, Report of the Advisory Committee for the Tropical Diseases Research Fund, 1913).

SANITARY ORGANISATION.

India.

In the Department of Education of the Government of India, there has been issued a very complete and interesting review of the present sanitary circumstances of India (Sanitary, Simla, 23rd May, 1914). After a short historical statement of progress, it is shown that it has been possible to move of late years at a better rate, in consequence of experience gained by the people as to the influence of insanitary factors on the spread and persistence of plague. India no less than England, therefore, will ascribe its sanitary awakening to the scourge of epidemics; for, in the latter country, the science of preventive medicine may be said to date from a severe epidemic of cholera in 1849, which claimed over 35,000 victims.

In respect to organisation, it is shown that Local Governments possess eight whole-time Sanitary Commissioners as their advisers on sanitary matters, aided by 26 Deputy Sanitary Commissioners, of whom one is temporary. The Local Governments have also nine Sanitary Engineers, aided by 16 Deputy Engineers, of whom eight are temporary. The Municipalities will be provided with 42 first-class, and 94 second-class Health Officers. In addition, the City of Delhi and its immediate surroundings have the special care of the Sanitary Commissioner with the Government of India, as well as of three Health Officers, two being temporary –aided by one Sanitary Engineer. When these do not already exist, the Government of India has advised Local Governments to take powers to require Municipalities to appoint Health officers, and to veto the appointment of an unfit person. These bodies have also been recommended to pursue the system already in force in Madras of employing technically trained Sanitary Inspectors in proportion to their populations. Training classes for Sanitary Inspectors are now being held in all the more important provinces. The Calcutta and Bombay Tropical Schools of Medicine will in the near future provide for the training of the superior officers of the Public Health Staffs. It is stated that "the policy of the Government of India is to keep the control of research under itself, but to decentralise other branches of sanitation. . . . In every Province Sanitary Boards have in the past been composed with varying powers, some being merely advisory, others having authority to sanction schemes and allot funds."

India has two Pasteur Institutes—one at Kasauli and the other at Coonoor; the third will shortly be in being at Rangoon; another is suggested for Assam. The Bacteriological Department possesses thirteen laboratory appointments, and has been recently strengthened by fifteen new appointments "for the prosecution of research work and direct investigation in the field." The laboratories available for research are the "Central Research Institute" at Kasauli, the Bombay Bacteriological Laboratory, and the King Institute of Preventive Medicine, Madras. A solid effort towards encouragement of research was made in 1911 by the foundation of the "Indian Research Fund Association." Funds amounting in the aggregate to £100,000 since its inauguration have been placed at its disposal by the Government of India. The present members of the Advisory Body are the Director-General, Indian Medical Service, the Sanitary

Commissioner with the Government of India, the Director of the Central Research Institute at Kasauli, the officer in charge of the Central Malarial Bureau, and the Assistant Director-General, Indian Medical Service (Sanitary); Sir Ronald Ross is an Honorary Consulting Member.

The following statement of policy is not commonly known and will no doubt be welcomed by those interested in tropical research :— " Besides financing the investigations of its own staff, the association gives grants-in-aid to outside research on approved lines." The results of the excellent research work of officers of the Indian Medical Service under these encouraging conditions will be made better known than formerly by a publication entitled the " Indian Journal of Medical Research,"* edited by the Director-General and the Sanitary Commissioner with the Government of India, in collaboration with numerous well known authorities.

In practical sanitation attention has been bestowed upon urban areas. The Government of India have been able to place large sums at disposal of the municipalities, which are being employed in town planning, improvement of conservancy, water-supply and drainage. Recently, the Government of India have intimated their willingness to permit funds thus given by them for urban sanitation to be in part diverted to rural requirements, provided Local Governments have before them practicable schemes.

Religious Objections to Sanitation.

Bentley, in his report on malaria in Bombay City, pointed out that the open wells afforded excellent breeding facilities for the *N. stephensi*†. The Bombay Corporation has accordingly required the inhabitants to close their wells, or to screen them. They are, however, meeting with numerous objections from the inhabitants, which they assert are made on religious grounds by Hindus. Objections of this nature are not likely to be founded on grounds that can be sustained, and but shield the excuse of custom, convenience, and the fear that, as happened a short time back when there was bursting of a main, there would occur shortage of water supply. Putting aside conservative objections to pipe water, which experience shows soon disappear in the presence of completed works, the excuse of the Hindu is that well water should be exposed to the sun if its purity is to be retained; whereas present day doctrine, founded on the experiments of the Massachussetts State Board of Health, is that subsoil water is not thus benefited. Whilst the Hindu may produce modern vernacular books supporting his opinion, it is impossible for him to do so by reference to the standard required by Manu, to which deference must be paid. It will be found that whilst Manu enjoined exposure of surface waters to sun action, no such injunction is given as to subsoil waters. This differentiation is in accord with the best bacteriological and hygienic teaching of the present day. Anyway, such attempts to block sanitary progress should be met by a careful scrutiny of the facts which are brought in support of religious objections.

* Now in its second volume.

† It may be said that about 1900 Major Cornwall, I.M.S., asserted that Anopheles bred in the open wells of the city of Madras.

Very rightly the British Raj stays its hand where these are justly pleaded, but confusion between erroneously founded custom and religion is apt to be taken advantage of to protect vested interests.

Ceylon.

The newly organised Sanitary Department in Ceylon has not been established a moment too early, having regard to the alteration of conditions of passenger traffic which the Indo-Ceylon Railway has brought about. Hitherto, a careful system of passing estate coolies through observation camps in the Madras Presidency* (whence the majority of labourers has been derived) before allowing them to embark for Ceylon, and the supply of information by the Madras Government as to epidemic diseases prevailing in the areas in which recruiting is conducted, have been factors of importance in preventing the spread of cholera and in the (former) immunity from plague. The necessity for increased care as to conservancy and water supply, upon which Sir Allen Perry insists, must therefore bulk largely in the primary efforts of the new Department.

Egypt and the Sudan.

Lord Kitchener's Report on the general progress of Egypt under his administration, contained in the White Book, Egypt No. 1, 1914, affords details of efforts to found a Public Health Service. Sir David Semple is now Director-General of the Public Health Department, and under him considerable reorganisation has been effected. The Lunacy Section and the Veterinary Section of the Service have been placed under the Minister of Agriculture, "so as to give the Public Health Department a free hand and more time to deal with problems appertaining to the health of the people." The hygienic laboratories have been extended and fully equipped, so as to form up-to-date bacteriological and chemical sections. In the former there are 12 to 14 workers, in the latter 4 to 5. The ophthalmic division has a staff of four inspecting surgeons and 30 hospital surgeons. The central organization is "a Board of Health composed of five members, with the Director-General of the Public Health Department as President." It is to be a consultative and advisory body without executive duties.

In recounting the work undertaken by the Department, special emphasis is placed upon efforts against bilharziasis and ankylostomiasis, and reference is made to the fact that the ova in the case of the former disease have been found in the tissues of the mummies of the 20th dynasty. In expressing hopes that the new organisation will be of benefit to the country in research as to infantile mortality, pellagra, infectious eye diseases, typhus fever and kindred diseases, Lord Kitchener holds that the time has arrived for practical efforts, because as "we are in possession of definite facts as to how these diseases are contracted, we are better able to apply methods based on knowledge which is the outcome of research. The building and equipping of hospitals is undoubtedly a worthy and, indeed, a necessary

*Maintained at the expense of the Ceylon Government.

object, but it fails to strike at the root of the matter. . . . Prevention is better than cure." The importance of education of the people and the teaching of elementary hygiene in schools are not overlooked, but Lord KITCHENER states, "in the meantime we are justified in taking up immediately active preventive measures to combat the prevalent diseases I have mentioned and steps in this direction have already been taken and will be pushed on with vigour." He then gives the outline of a scheme for sanitary organisation in rural areas as follows :—

"The organisation of a system of village sanitary inspection, consisting of about one inspector for ten villages, who would report to the Markaz doctor all that happened in regard to health questions and sanitary matters in the villages under his charge. A soldier who had served his time and become a non-commissioned officer in the Egyptian army, with a little training in this kind of work, would probably make a very suitable sanitary inspector. The improvements in the villages themselves would then proceed on lines of proper conservancy (which would do much to prevent ankylostoma and bilharzia infections), the filling up of "birkas," the erection of decent, ventilated houses, and the arrangement of a purer water supply."

A travelling ankylostoma hospital has been organised and is pronounced "a marked success." In this connection it is stated that it is intended to introduce conservancy in the villages, a precaution held to be fully justified by results in a German colony, where the proportion of ankylostoma "carriers" was reduced from 64 to 10 per cent. Lord KITCHENER'S views as to the relative positions of sanitation and education in securing advance are expressed as follows :—

"The spread of education and improvement in sanitary conditions should proceed hand in hand, and in this direction Provincial Councils are doing good work. . . . I am glad to say that while large sums are spent on education the interest of the Councils in works of public utility has in no wise abated. They have devoted much attention to various schemes for the improvement of sanitary conditions in villages and, as I have mentioned elsewhere, the welfare of the infant population has been the object of their special solicitation."

The remaining parts of the Report teem with statements of strenuous efforts towards the economic development of Egypt and the Sudan—prominent amongst which are great irrigation works, which not only bring water to the land, but are supplemented by carefully designed drainage works for economising water and *ridding the soil of surplus moisture*—a type of work which, in the interest of malaria prevention, is undesirably rare in certain countries where "wet crops" are a special agricultural feature.

AMERICA.

The following is the definition given in the U.S.A. Public Health Report No. 3, of January 17th, 1913, of the objects of Federal Public Health administration : "The jurisdiction of the Federal Government in public health matters extends over foreign intercourse, interstate intercourse, Federal Territory, and Federal Administration matters, including protection of Indian tribes." The first legislation—bringing ultimately the present organisation into existence—was enacted in 1796. Impetus was given to development by an extensive epidemic of yellow fever in 1878, and possibility of invasion from Europe by cholera in 1893. Practically, all quarantine measures are conducted

by the Service under rules which are placed automatically in force on occurrence of infectious diseases; so that it is not necessary, as in British practice, to declare quarantine against any particular foreign port. American consuls in foreign ports are required to enforce rulings as to American vessels; and at numerous important foreign ports medical officers of the Federal Public Health Service issue bills of health, and report on sanitary conditions and the existence of infectious diseases. Immigration, which is of course still extensive in the United States, is with the aid of international agreements subject to supervision by the Public Health Service. Diseased and the mentally and physically unfit immigrants are rigidly excluded. Hospitals in connection with quarantine and immigration are controlled by the Public Health Service. The Federal Government has the right to issue laws and enforce action in any State in the event of neglect as to epidemics; but in ordinary conditions requests for aid by the Public Health Service emanate from the States concerned, each being expected to use its own staff fully. Aid thus given "may be advisory in character, or may assume a more active form." The Federal Government places yearly on its Budget a sum for measures in preventing epidemics.

During epidemics the opportunity is taken by the Public Health Service to collect information and to study causation; as it is held that "the successful administration of public health laws depends essentially upon a knowledge of the existence and current prevalence of communicable diseases, the conditions that favour their propagation and spread, and the measures that are required for their control." Results secured are published by the Government in various periodicals. These publications have proved of wide world interest and sanitary utility. Research in sanitary interest is an important function of the Public Health Service, by both laboratory and field investigation. Research was from 1901 to 1912 arranged in connection with the Hygienic Laboratory, Washington, but in the latter year recognition was given to research by an Act of Congress. Powers were afforded to the Public Health Service "to study and investigate the diseases of man and conditions influencing the propagation and spread thereof, including sanitation and sewage and the pollution either directly or indirectly of the navigable streans and lakes of the United States."

The Public Health Service has "approximately a corps of 450 medical officers, 50 pharmacists, and a total personnel of 2,000. The Service is a bureau of the Treasury Department of the Federal Government. This is controlled by a Surgeon-General of the Public Health Service, whose central office has for administration purposes the following divisions:—1. Personnel and Accounts. 2. Foreign and Insular Quarantine and Immigration. 3. Domestic (Interstate) Quarantine and Sanitation. 4. Sanitary Reports and Statistics. 5. Scientific Research. 6. Marine Hospitals and Relief. 7. Miscellaneous.

SANITARY RULINGS.

Zanzibar.

The Protectorate of Zanzibar has adopted a Dairies Decree, No. 5 of 1913, which follows closely "the main provisions of the "Pure Milk Bill," which has not yet come into force in Great Britain." This is said to work satisfactorily, except that the power to test cows with tuberculin is somewhat vague. Powers are reserved so that the First Minister can revoke or alter any rule.

Previous to 1913, medical examination of children and schools was carried out; since March of that year, however, this arrangement has been expanded so as to embrace all sanitary details of the children and their environment.

Gambia (Bathurst).

Dysentery, tick fever and tuberculosis have been added to the list of notifiable diseases. Power to control excavations and to specify spots where latrine contents may legally be deposited has been acquired.

Uganda.

Rulings as to sleeping sickness have been revised so as to include "further large tracts of country in the Eastern and Western Provinces under infected areas." In the interest of anti-mosquito measures rules have been made applicable to Entebbe "giving powers to remove all pineapples, bananas and other water-holding plants from residential quarters."

In all townships, the area of buildings is restricted to one half of any town plot.

Honduras.

An Ordinance has been passed with the object of preventing dealers from foisting on the public the cheaper brands of skim milk. In Hong Kong this idea has been carried a step further, by requiring "tinned" skim milk to be labelled, "Not fit for feeding infants under 1 year of age." In the Philippine Islands Dr. Heiser, in mentioning the foregoing fact, states that it is proposed to meet requirements by so taxing skimmed milk as to forbid competition with the unskimmed brands.

Egypt and the Sudan.

It is proposed to arrange that demands for increased expenditure by Departments must be presented for sanction in principle in advance of the Budget, so as to secure "adequate discussions of each proposal separately." This sensible ruling is already in force in India, in respect to Government Departments. A particularly useful modification of the same principle in the Madras Presidency requires a Local Authority, before placing a Budget for sanction by its members at a meeting, to afford the District Medical and Sanitary Officer the opportunity of urging sanitary requirements by advising alteration of figures. After a Local Authority has passed its Budget in the Madras Presidency,

it is subject to review by the Surgeon-General with the Government on medical matters, by the Sanitary Commissioner on all sanitary matters, and by the Sanitary Engineer on charges for maintenance of sanitary works; opinions thus received having been considered, Government passes final orders consistent with self-government principles of Local Authorities.

Italian Law 460 of 1901.*

Under the above law malarious zones can be defined. In proclaimed zones, local bodies are required to supply quinine free when prescribed by the recognised local medical officer. All Government contractors are bound to supply quinine and medical attendance to labourers gratuitously. The quinine so supplied must be that sold by the State. Within the malarial zones, all public offices, all railway buildings, all buildings used by Companies and by Government contractors, must be protected from the "penetration of aerial insects" from June to December. Proprietors and manufacturers who similarly protect buildings or temporary sheds will, on the proposal of District Sanitary Boards, receive money rewards not exceeding 1,000 francs from the Malaria Fund; where physically possible, landholders are required to prevent interruptions to the natural flow of water, and the formation of stagnant pools or puddles in slight depressions of soil artificially created.

Road and canal contractors are to avoid leaving side pits, in which when they are abandoned water stagnates, and altering the lie of the soil in such a way as to cause the formation of puddles.

The Law is followed by a code of rules for its practical application. The rules assign to the various administrative and sanitary officers their various duties; give detailed definitions of, e.g. "labourer;" provide for the supply of quinine to labourers moving from a malarious zone to another place in search of labour, and for the opening of quinine depôts by private persons where there is no dispensary within two kilometers; impose penalties on sanitary officers who fail to denounce contractors; explain that protection against "penetration of aerial insects" means wire gauze; declare that Government, local and railway officials who disobey the law will incur the penalty prescribed in article so and so of the sanitary law; lay down that engineers and contractors will only be allowed to open pits for road and canal work after demonstrating the necessity to the Chairman of the Union, and getting a license from him, and on condition of filling the pits up within a time to be fixed. Lastly, special rewards are promised to people who cultivate rice in such a way as not to let the water stagnate and become a breeding place for the anopheles; and to people who supply articles for the protection of the person to their coolies.

* Adapted from "A.G.," in the *Madras Mail*, 1904.

Anti-Malaria Italian Regulation of the 3rd February 1809, *showing distances then considered necessary.*

Of Rice Lands.

1. In future no one shall be permitted to convert land into rice fields, without the special permission of the prefect of the department in which the land is situated. . . . .

3. Permission to establish new rice fields can be granted by the prefects only under the following limitations, viz :—

First.—That the field so established shall be at a distance from the capital of the kingdom, of at least 8,000 metres (4·97, or say 5 English miles).

Second.—That they shall be distant from communes of the first-class and fortified places, at least 5,000 metres (3·10, or in round numbers, 3 English miles).

Third.—That they shall be distant from communes of the second class, at least 2000 metres (1·24, or 1¼ English miles).

Fourth.—And finally, that they shall be distant from communes of the third class at least 500 metres (0·31 English miles, or about 530 yards).

4. The distance prescribed in the foregoing article shall be measured in right lines from the exterior walls ; in the case of walled space, and in that of open places, from the last house which forms part of the aggregate habitations of these places.

5. The rice fields now existing within the distance prescribed for the capital shall be adapted for other cultivation, within the space of three years from the publication of the present decree, under the penalty specified in article 2. . . . . .

Of Marcite and Irrigated Meadows.

8. It is forbidden to establish constantly or periodically irrigated meadows in the interiors of inhabited places.

9. By the close of the present year all such meadows shall be adapted to other kinds of cultivation.

10. It is equally forbidden to establish such meadows in the vicinity of communes of the first class of fortified places, without the permission of the prefect.

11. This permission shall be granted only on the following conditions :—

First.—With respect to the capital, the irrigated lands shall be distant 1,000 metres at least (0·62 English miles, or about 1,000 yards).

Second.—With respect to the communes of the first class and fortified places, the lands shall be distant 500 metres at least (about 530 yards).

The distances shall be measured as for rice lands.

TREATMENT OF WASTE.

Disposal of Sullage.

The following quotation from the Medical and Sanitary Report (1913) of the Uganda Protectorate depicts by no means rare conditions in tropical towns, where sanitation is still "in the making":—"With the growth of towns the need for the establishment of proper drainage systems on a permanent basis becomes more pressing every year. In Kampala, especially, slop water and other filth accumulates in the badly graded earth drains in the streets, constituting a nuisance which the small Municipal staff is unable to deal with." Also it is by no means rare for the sanitarian to find his desire for improvement thwarted by the official regret of "want of funds." But even if radical methods must for financial reasons be put aside, it is at times possible to secure at least some mitigation of conditions, pending better times. To this end a description of certain cheap methods the writer has from 1895 onwards excogitated may be of some utility as "makeshifts." Dr. Vivian Poore made several suggestions of the type required, where the end subserved was securing the nitrifying action of soil and disposal by soakage. For example, his excellent trench for disposal of house refuse-water is referred to and depicted in the East Africa Protectorate Annual Medical Report for 1912. The writer's little arrangements were, however, adaptations of the principles which were worked out by the Massachusetts State Board of Health between 1888 and 1890.

In this research work, essentially in favour of applied hygiene, the Americans preceded other nations. Their definition of conditions necessary for purification of sewage by aerobic filters was at once simple and exact. They showed that the nitrification of sewage in filters depended upon the passing of films of the fluid "over the surface of stones with air in contact," and that a filter so arranged that aeration shall occur at reasonable intervals resulted "in the removal for some months of 97 per cent. of the organic nitrogenous matter as well as 99 per cent. of bacteria." In their Report for 1890, the Board stated that "the mechanical separation of any part of a sewage by straining through sand is but an incident which, under some conditions, favourably modifies the results, but the essential conditions are very slow motion of very thin films of liquid over the surface of the particles that have spaces between them sufficient to allow air to lie in contact with the films of liquid.....With these conditions it is essential that certain bacteria be present to aid the process of nitrification."

If the principles thus stated be held in mind, it is an easy matter to make adaptations both for disposal of sewage, and household and trade waste waters, as well as to facilitate night soil conservancy. The adaptations by the writer now described are strictly "makeshifts" and do not pretend to more than a grade of bacterial efficiency, but the chances always are that by assuming so low an effectiveness as treatment of from 90 gals. to 150 gals. per sq. yard per 24 hours, considerable bacterial and chemical efficiency is secured, whilst the physical improvement of sewage is readily demonstrable. The material used in strata as shown in the accompanying diagrams

has been chiefly washed gravel of graded sizes, and sharp clean sand; but it is obvious that when these are not procurable broken stones of various grades, old pottery, over-burnt brick, broken china, coal, furnace slag, coral shells or selected hard cinders, can well replace the gravel, and finely broken stone and selected cinders or laterite pebbles the sand. Aeration of the filter material is sufficiently provided for by the normal intermitting of discharge of domestic and, frequently of trade, waste fluids. In working, replacement of material should be avoided as nothing short of prolonged flooding—without sufficient "breathing" (aeration) time—of a filter would put it out of action. A filter that has been in use for some time is at an advantage, in that it is well "seeded" with nitrifying organisms. The surface sand must be kept clear of bulky deposited matter, and be occasionally gently raked to secure aeration if showing signs of clogging, and only on this condition being irremediable by this means should fresh sand be used.

Diagram A shows a household filter to which the name Vizianagram (that being the first place to adopt it) was given. By getting the householders of a street with imperfect side drains to use this at each house under just such circumstances as depicted at Kampala, all nuisance was got rid of. This, however, presupposes that there is a general removal of sewage soaked earth before the filters are brought into use, otherwise the purified water finds in the soil putrescible matter. The Chairman of the Vizianagram Municipality thus describes physical results:—"The domestic sewage filter made when you were here is working excellently well. I have seen the filter myself, and found the dirtiest sewage that is let into it coming out so pure that the water will be accepted for drinking by any human being who has not previously known that it was filtered sewage."

A variation of the form is found in Diagram B. This is an adaptation of Lowcock's method of forcible aeration of filtration media. This was used immediately outside a public latrine, so as to receive urine and ablution water; another was employed to receive the domestic sullage and urine and ablution water from a household of eight persons. The filtrates were disposed of by soakage on the surrounding soil in both cases. Both the filters and their surroundings remained odourless. The time consumed for aeration by a common hand bellows must have been under two minutes daily.

But soakage on the soil in the immediate neighbourhood of a house should, of course, be avoided when feasible. A search for a vacant plot of ground should be made, which can be rendered available for vegetable, grass or flower gardening under sewage.* Such a plot may often be utilised by leading sewage to it by a makeshift open drain.

Many cheap methods of securing makeshift drains are available, but perhaps the cheapest is the lining of a side drain with puddled clay, and placing upon this lining common roof pan tiles with their concavity upwards. Preferably, these tiles should be dipped in, or

*From private houses in India, in towns not provided with a water carriage system of night soil disposal, the household waste water would contain the urine, ablution water and washings of latrines in addition to the usual constituents of household sullage; it is therefore a sewage.

painted with, a mixture of boiling tar and pitch. The joints may be made with lime mortar painted with the tar mixture, if cement cannot be afforded. By this means sewage from several houses can be brought to a sewage disposal plot. Here it can be received in a covered sewage well of tar soaked brick, with a backing of puddled clay—or, in the absence of cement, lime concrete. If funds will allow, this should be correctly trapped and ventilated. This sewage collecting well can be emptied best by the wooden lever and bucket arrangement known as the "picottah" or "shadoof." Excellent results could be thus obtained, especially in growing grass for fodder, by broad irrigation of sewage on small plots within a town,* but both for agricultural and sanitary reasons, a sewage which has undergone nitrification would often be preferred.

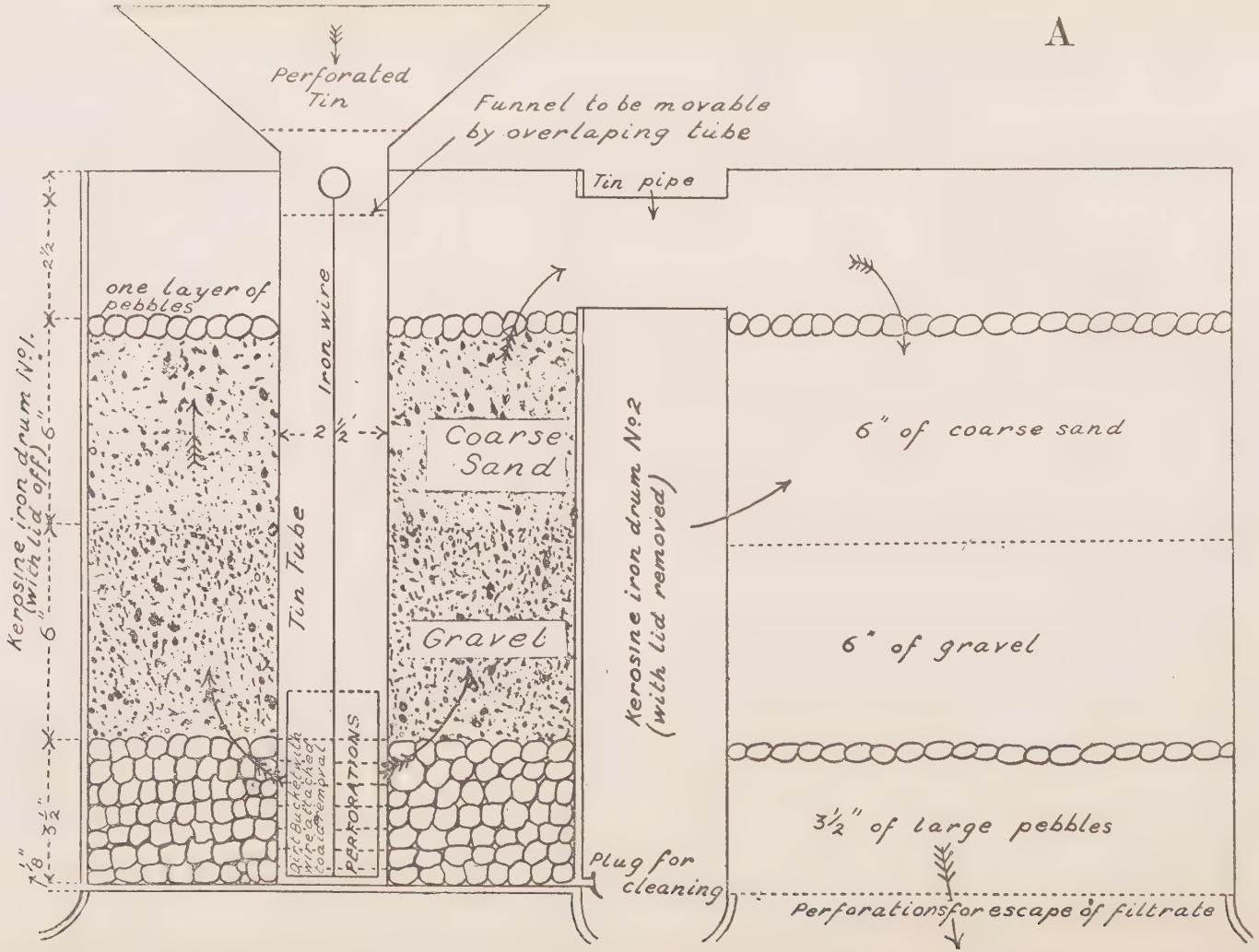
In this case, the use of a simple form of aerobic filter, such as shown in Diagram C, will fulfil requirements. This was first introduced in 1895 by the writer in Vizagapatam and, as a matter of convenience, the filter was named accordingly. The object here was the interception and filtration of a considerable body of sewage from a section of the town which was allowed to flow into a marsh, constituting a nuisance. An energetic District Medical and Sanitary Officer (the late Major Vickers, I.M.S.) and the Indian Chairman of the Municipality ultimately filled the marsh, and pursued cultivation with the filtrate from a larger filter. The physical character of the filtrate of the original filter was thus described by the Chairman:—"The amount of sewage daily dealt with is about 7,200 gallons (= 750,000 gallons per acre), the filtrate is clear and looks like pure water. At first, a few days after the filter began to work, the filtrate tasted brackish; now it is not so."

The trench filter shown in Diagram D is the modern substitute of the "soak-pit"; its action was fully studied by the Massachussetts Board of Health. In this not only does purification by aerobic action take place, but by lateral soakage in the soil final disposal occurs. It is an excellent arrangement when dealing with sullage from detached houses, and in camps. Care is required to see that the sullage water is correctly distributed over the surface of the filter. This can be easily effected by placing earthenware half tiles with the concavity upwards but with open joints—after the style of the makeshift drains above described. The writer has secured good results in abolishing mosquito breeding spots by using these, in the absence of a drainage system, to receive the waste from service taps of pipe water systems. If care is taken to make the length of a trench filter coincide with the trend of the surrounding surface, it will act well notwithstanding heavy rain if the soil be fairly permeable.

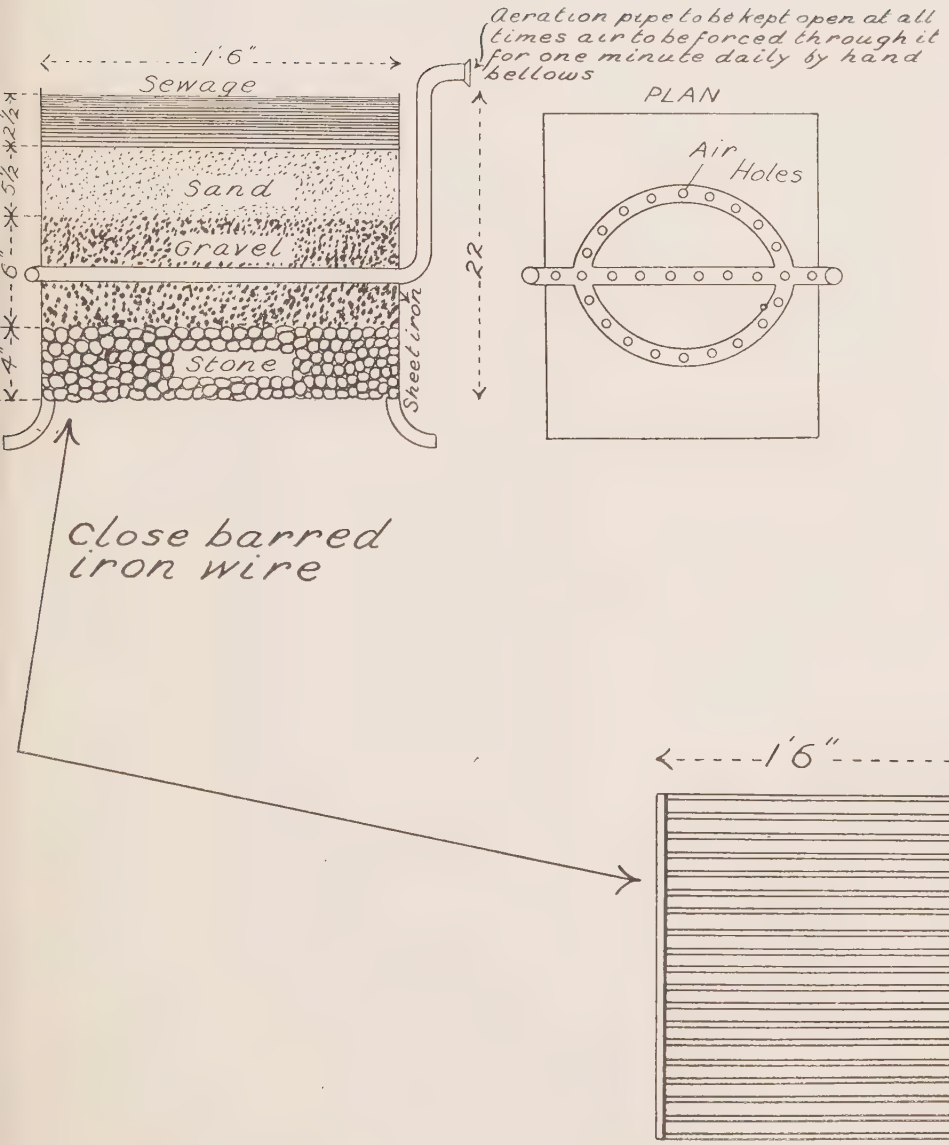
Provided that by allowing intervals of rest aeration is secured, there is no reason why a filter of the pattern of Diagram C should not be constructed below ground, so as to receive sewage direct upon its surface by gravitation from a drain, instead of it being necessary to lift it by mechanical means. In this case, the filtrate could be

*No one would elect to use sewage irrigation within a town if it could be avoided. It must be understood that this "makeshift" method is merely an improvement upon allowing pools of sewage in streets with attendant stench and culices.

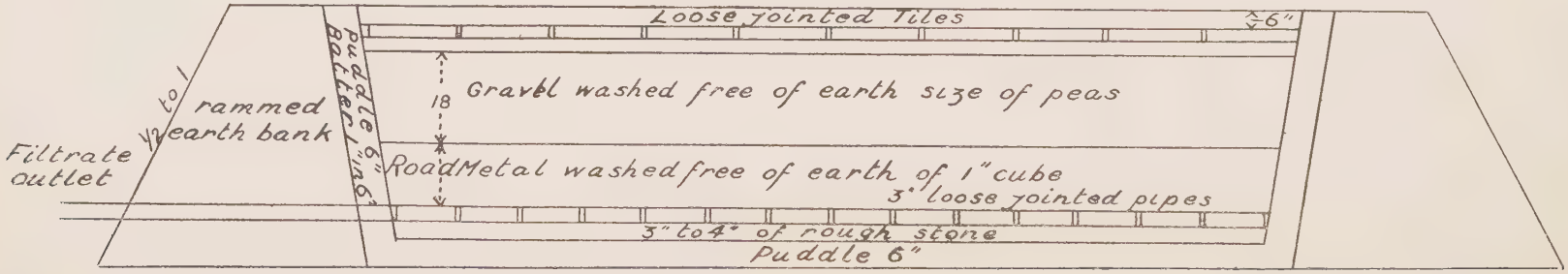
A


Perforated Tin
Funnel to be movable by overlaping tube
Tin pipe
one layer of pebbles
Iron wire
Tin Tube
2½"
Coarse Sand
Gravel
PERFORATIONS
Kerosine iron drum No1. (with lid off)
6"
2½"
3½"
7/8"
Kerosine iron drum No2 (with lid removed)
6" of coarse sand
6" of gravel
3½" of large pebbles
Plug for cleaning
Perforations for escape of filtrate

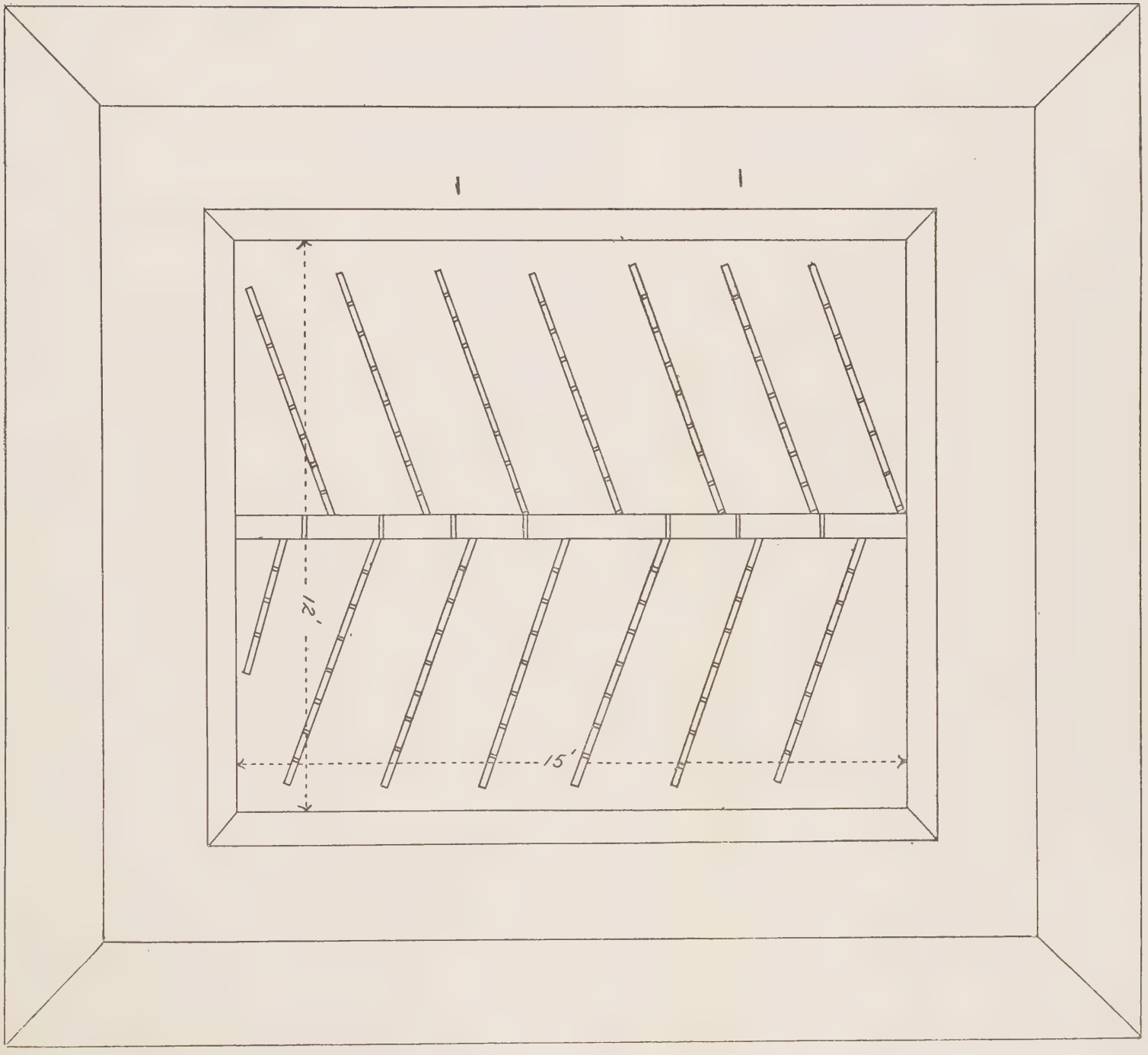
B


Aeration pipe to be kept open at all times air to be forced through it for one minute daily by hand bellows
1'6"
Sewage
Sand
Gravel
Stone
Sheet iron
2½"
5½"
6"
4"
22"
PLAN
Air Holes
Close barred iron wire
1'6"
1'6"

C
(section)



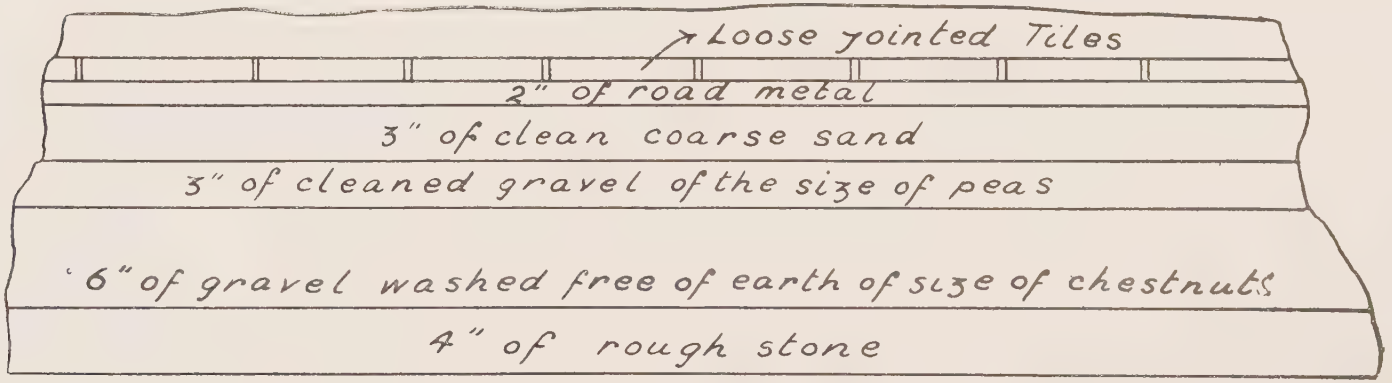
Aerobic filter.



C
(plan)

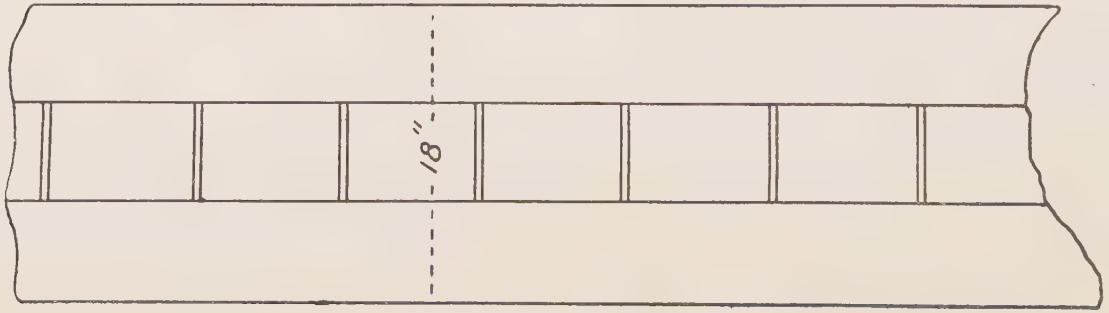
Aerobic
filter.

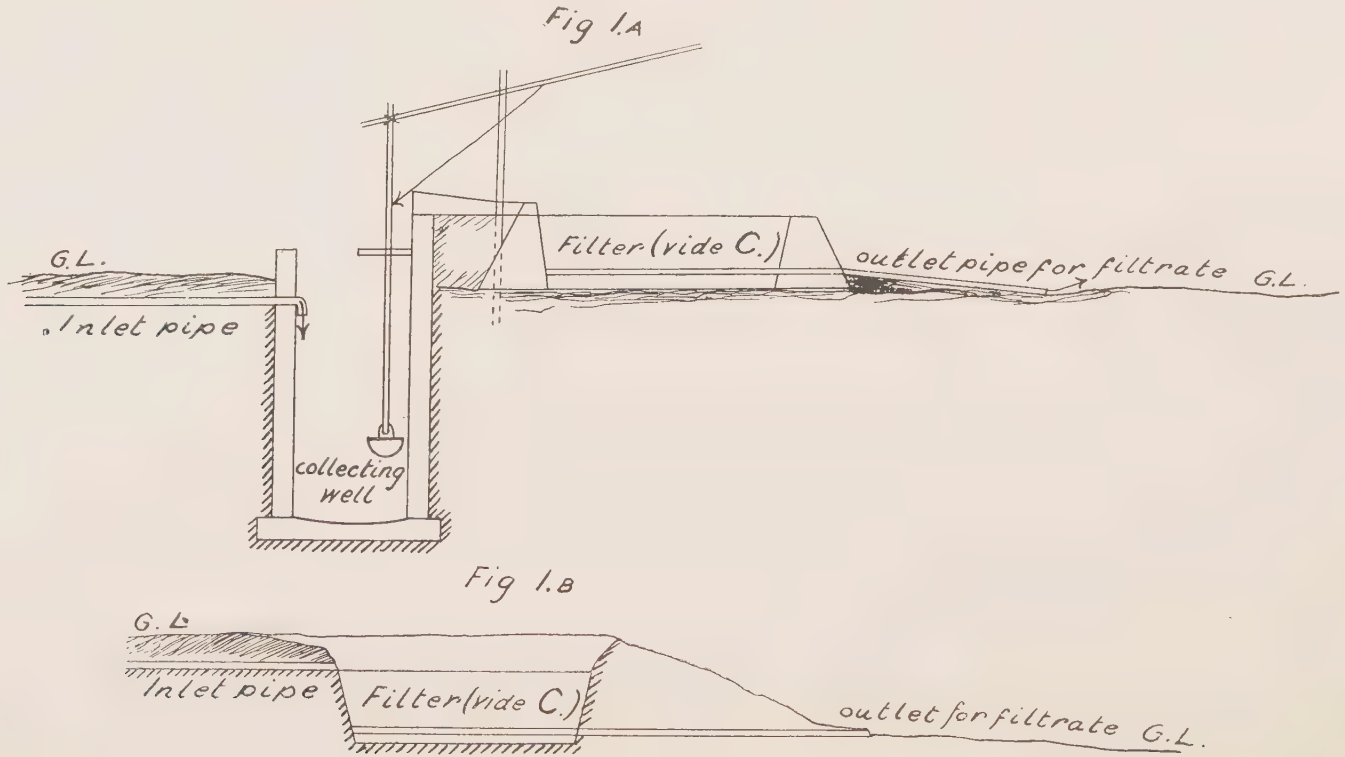
D (section)


Loose jointed Tiles
2" of road metal
3" of clean coarse sand
3" of cleaned gravel of the size of peas
6" of gravel washed free of earth of size of chestnuts
4" of rough stone

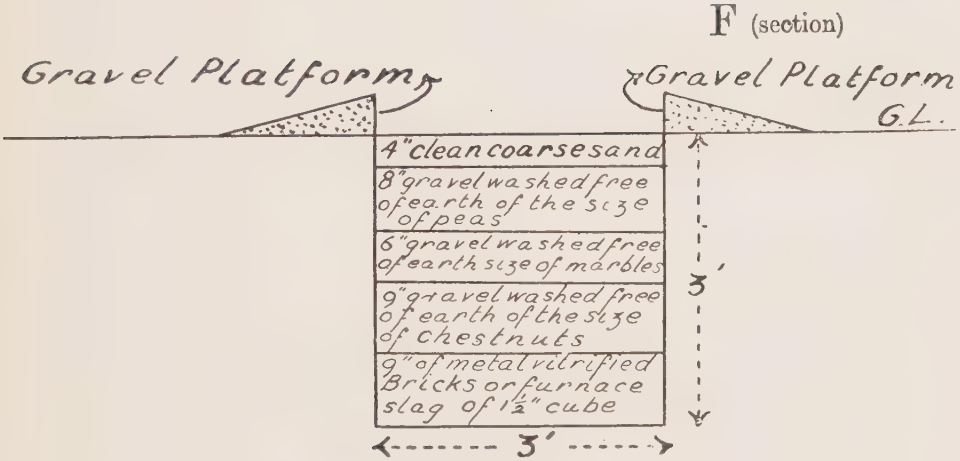
Filter trench.

D (plan)

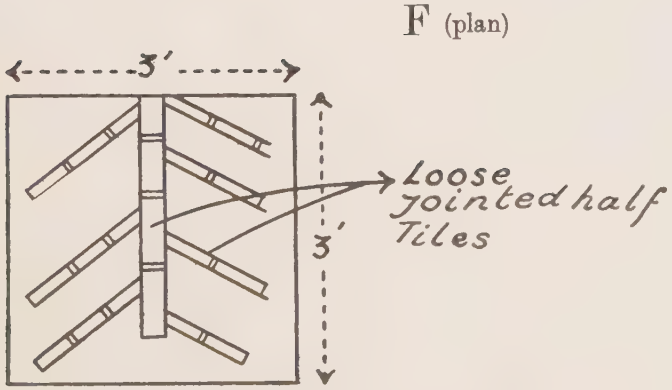




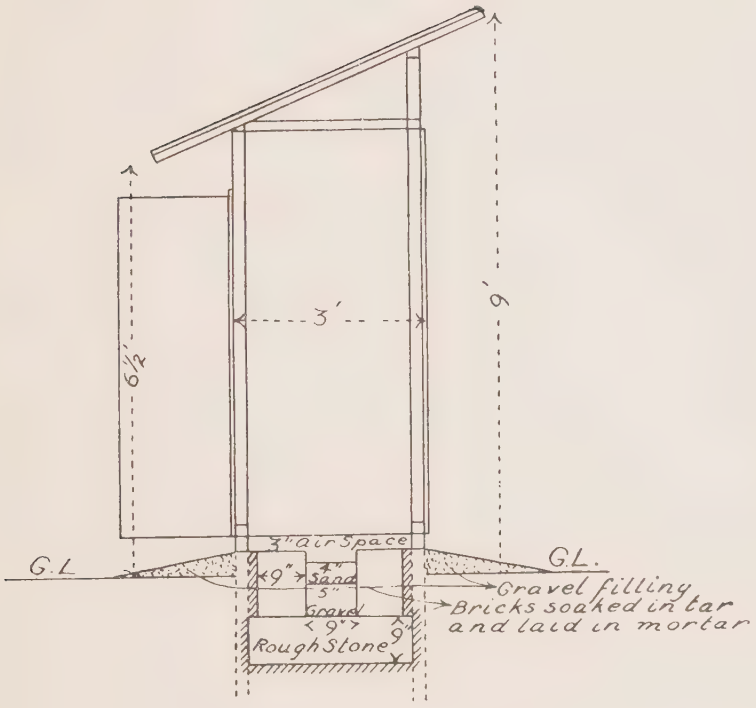
Alternative modes of using Aerobic filter (Diagram C).


F (section)
Gravel Platform
Gravel Platform
G.L.
4" clean coarse sand
8" gravel washed free of earth of the size of peas
6" gravel washed free of earth size of marbles
9" gravel washed free of earth of the size of Chestnuts
9" of metal vitrified Bricks or furnace slag of 1½" cube
3'
3'

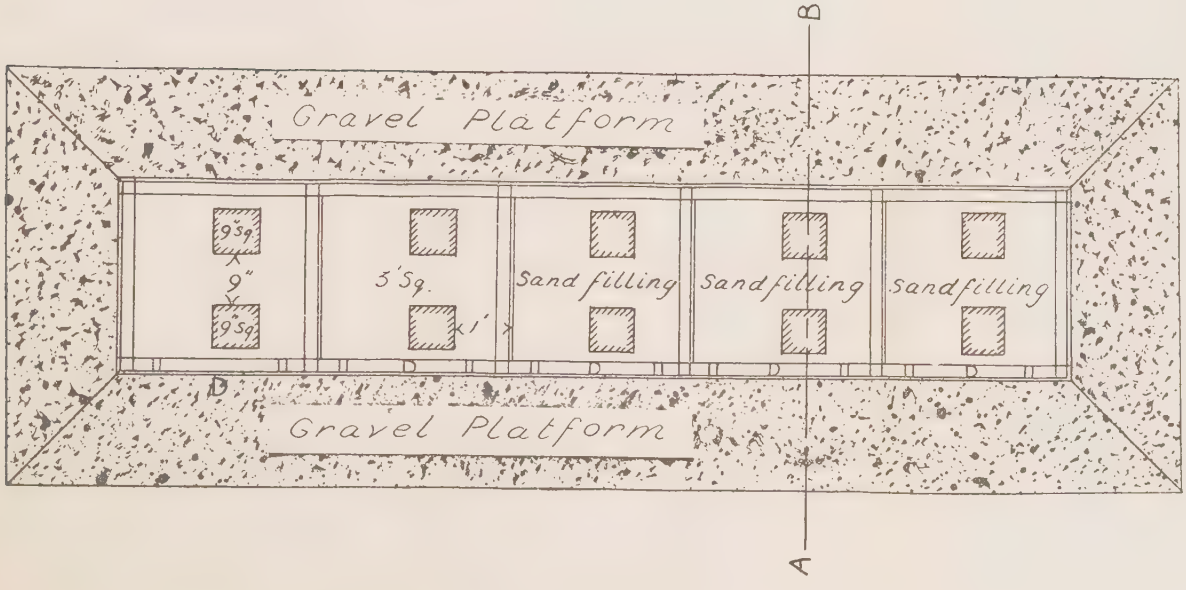
Filter pit.

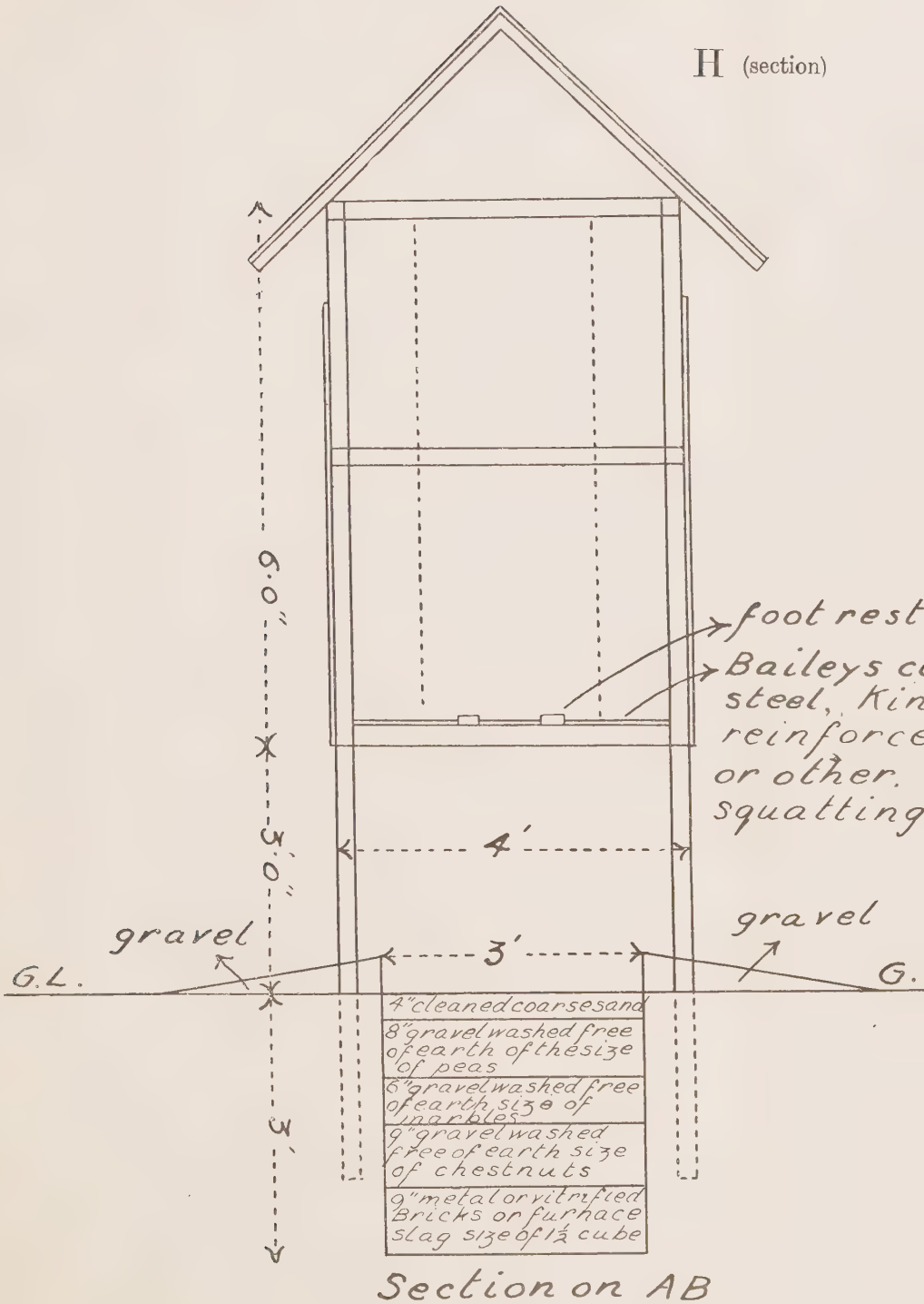

F (plan)
3'
3'
Loose jointed half Tiles

G



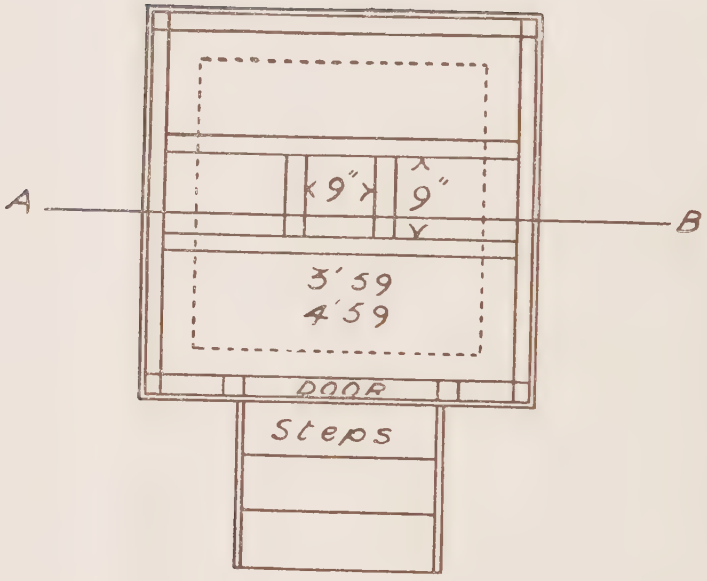
Filter trench latrine.





Filter pit latrine.

H (plan)



npressed
s
l concrete
atrine
plate

conducted for discharge to a lower level (Diagram E, fig. 1, B). Again, in place of the longitudinal trench and its lateral soakage, excellent results can be obtained with a cubic yard of filter material arranged slightly below ground level and trusting to soakage of the filtrate. In fairly permeable soil, temporary partial water-logging of such a filter does not stay its efficiency. These do excellent service in getting rid of water from bath rooms, kitchens, pantries, etc. (Diagram F).

The Filter and Night Soil Conservancy.

The desirability of separating the urine from the faeces in direct methods of collection has been long recognised, and is usually supported by the stereotyped statement that the admixture favours decomposition and the emission of objectionable odours. In India, the further objection holds that in the use of buckets for simultaneous receipt of urine and faeces, splashing of the person in the act of defaecation is liable to occur—a disastrous matter in respect to caste. But in the presence of the official "want of funds," there is a much stronger and little recognised reason why, in systems not depending upon water carriage, separation of faeces and urine should be aimed at, namely, that the cost of transport of faeces is trivial compared to any effort that could honestly remove from a town all urine, irrespective of the fact that the use of ablution water adds largely to the bulk in certain races in the tropics. In systems somewhat more advanced than the "makeshift," it is possible to attain this by special mechanical arrangements with much greater initial economy than by any of the water-carrying methods; but adaptation of the aerobic filter secures a reasonable compromise between "want of funds" and sanitary essentials, by disposing of all urine and ablution water on the spot and leaving comparatively dry faecal matter alone to be dealt with by transport. This means that conservancy plant may have (in dealing with tropical races subsisting on vegetable diet) five times less capacity than where the transport of both urine and faeces simultaneously is dealt with. In proportion power and cost for traction is reduced.

A glance at diagrams G and H will show that the trench and pit filters readily lend themselves to the separate treatment of faeces and urine. In the trench filter, a cleanly and firm foothold in squatting is obtained by wedging tarred brick masonry or tarred wood upon the gravel foundation.* Care must be taken to see that the footrests for the squatting position occupy exactly the sites shown in the plan, so as to attain proper utilisation of spaces for faecal deposit and the act of urination, respectively.

In the case of the filter pit latrine, the sentry box-shape of the superstructure, as used by Burmans over cesspits, is shown. Any mat and thatch or corrugated iron structure would also suit requirements. It is possible to adapt several forms of impervious platforms to this, but it is desirable that the foot-rests are so sloped from before backwards that all persons squatting shall uniformly be in the position that ensures the urine shall be received on a separate part of the sand surface.

*Glazed stoneware foot-rests would be still better, if funds will run to it.

In cleaning these latrines, the faecal matter is removed with as little adhering sand as possible. As the mass is deprived of much moisture, the collection is rapid and cleanly. It should not be difficult to render these latrines fly-proof. The writer's successor as Sanitary Commissioner in Burma, Lt.-Col. C. E. Williams, has encouraged the use of these latrines and has reported officially :—" Latrines A and B [Filter trench and pit latrines shown in the accompanying diagrams as G and H.] I have tested the latrine for many months with excellent results. Latrine A is on the same principle. . . . The filter trench is all right so long as at least the upper 12 inches of the soil is not water-logged. I have used it with a layer of paddy husk spread over the sand. The paddy husk is removed with the solid excreta. There is no offensive or urinous smell, as is usually the case in a Horbury latrine." He however considers the height of the platform in the pit filter latrine (intended to give space for removal of faeces and loading of filter) to be in excess of requirements.

In the writer's opinion these cheap makeshift latrines might usefully displace the " salgas " and " choos " largely used by natives in some of our African colonies.

Water Supply or Drainage First ?

This matter is thus dealt with by the Government of India Resolution, Department of Education—Sanitary—of the 23rd May, 1914 :—" In the beginning precedence over drainage was given to piped water supply, but experience has demonstrated the advantage of introducing both concurrently. Without drainage there is no means of carrying off the surplus water, and without piped water supply it is difficult to flush the drains properly." This is a ruling that is obvious. If the money be forthcoming, both should be accomplished at the same time ; or, better still would it be if the drainage system were pushed ahead of the water system. Such matters are, however, usually ruled by financial possibilities of communities ; and in India, where water-supplies are not financed by companies but by Local Authorities, the pledging of credit for loans of thirty or more years has hitherto forced the question as to order of urgency. The assurance of the Government of India that simultaneous efforts can now be made is a comforting sign of increased prosperity. Having regard to the prevalence of water-borne diseases and parasitic affections, there can be no doubt that in less prosperous days the sanitarian, whilst regretting that funds for both water and drainage systems could not simultaneously be secured, rightly gave precedence to water supply—taking care to guard the evil of surplus water, as far as feasible, by makeshift methods of drainage.

Incineration of Night Soil.

To incinerate night soil is an ideal long sought after by the sanitarian. Its accomplishment has been recorded from time to time by various methods, but it cannot be said that any mode has yet been suggested that would encourage the hope of universal adoption. To raise the temperature of 1·3 gallons of water from 40° to 212°F.

requires one pound of wood; to evaporate the water from faecal matter, which contains about 75 per cent. of water, is therefore no light task when a large population is dealt with. If the urine accompanies the faecal matter (*plus* ablution water) the task is proportionately increased. Unless, therefore, there is no stint of good fuel used in a reasonably constructed incinerator, the general experience is that the chances of continuous success of an incineration system for night soil are small. The usual difficulty of reaching the ideal is thus stated in the Annual Medical Report of the Uganda Protectorate: "I regret to state that the incinerators at Kampala have latterly not proved as successful as I anticipated; this is partly due to their repeatedly requiring structural repairs, but chiefly due to lack of efficient stoking, as it has been found that the natives object to the work; consequently a large portion of the night soil has had to be buried." The task of the small forms of incinerators devoid of forced draughts must at all times be subject to difficulties, occasioned by variation of labour and grade of wetness of the load, according to season. The writer has found some aid to the securing of draught by fixing over an incinerator chimney an ordinary ventilating cowl, acting by aspiration by facing the wind. He believes also that it should be possible to get excellent results by arranging a detachable Root's blower worked by a small kerosine oil engine, aided by a kerosine spray.

Fly-proofing of Latrines.

In the *U.S. Public Health Reports* for January 10th, 1913, Dr. C. Terry gives an excellent illustration of the necessity of fly proofing latrines in Jacksonville. His investigations as to prevalence of typhoid showed that water-supply might safely, and milk supply might reasonably (with the exception of three instances in the case of milk) be excluded. In the city over 8,500 privies existed, of a type and in a position in respect to dwellings highly favourable to transfer of infective material by flies. In 1910, there were 329 cases of typhoid with 62 deaths. By April 1st, 1911 (the beginning of the fly season), 80 to 85 per cent. of all privies were, by a City Ordinance, rendered fly proof. In 1911, there were 158 typhoid cases with 40 deaths, in 1912, there were 87 cases with 16 deaths. In only 38 of these cases was the typhoid of Jacksonville origin. Whilst before the introduction of fly-proofing the portion of the city chiefly infected was that within the area served by privies, subsequent to this there has been no such disproportion. Dr. Terry concludes:—

"The only change in sanitary condition throughout the city has been the fly-proofing of the privies. Contact has undoubtedly played its part, as it does everywhere, but, in view of the fact that our milk and water supplies could be eliminated, as already stated, I feel that we are justified in attributing the major portion of our cases, prior to the enforcement of the privy law, to the house-fly."

In certain of our African colonies typhoid fever in natives exists, but so far as traced in very small numbers; dysentery is better known, yet, irrespective of the ordinary health requirements of the native population, fly-proofing of latrines has made little progress even within the compounds of Europeans. An ordinary arrangement is

the use of a trench for native servants, which is also used for deposit of faecal matter from the European houses. The deposit of dry earth when carried out on a scrupulously exact system may mitigate possible results from fly-borne matter; but it would seem but reasonable to fly-proof such trenches, including those of the filter variety we have described. The faecal deposit trenches could be cheaply fly-proofed by making a readily moveable structure of angle iron with corrugated iron roof and sides fitted in with wire screens. If the sides were built with a sharp slope, as should be the case (to secure stability and prevent the space at the sides of the trench being used for defecation) the fitting of a self-closing door would be an easy matter.

Flies and Food Contamination.

C. Wardell Stiles, Professor of Zoology, Hygienic Laboratory, U.S.A. Public Health Service, has endeavoured "to find a method to determine the existence, or probable existence, of faecal contamination of food." He points out that the *Entamoeba coli*, *Lamblia duodenalis* and *Trichomonas intestinalis* are residents of the human intestine, and that all three possess "a spore stage that can be recognised by the microscope." Whilst suggesting that it is possible these spores might be carried to food by dried night soil as dust, he considers that this being excluded the finding of these spores on food justifies the conclusion that they have been carried hither by flies (*U.S. Public Health Reports*. 1913. Feb. 14. Vol. 28, No. 7).

Flies as "Carriers."

The connection between eating of mangoes to excess and the spread of cholera more readily appeals to the lay mind than that the fruit has been contaminated by cholera microbes. The following description of conditions by the Medical Officer of Health, Bathurst (Dr. A. F. Kennedy), if placed before lay authorities when a locality is threatened with cholera, may hasten their action as to night soil conservancy:—"Several collections of larvae from cesspits were bred out before the rains; all produced the same kind of fly, which was identified as *Muscidea, Pycnosoma* [sic]. The chief fruit in season, practically the only one, was the mango, and these flies were frequently found feeding on the discarded mango stones about the streets. Uncovered dustbins and refuse attracted them, and they were generally to be seen in the market, commonly on the meat. Systematic treatment with crude carbolic acid largely diminished their numbers." In this connection an apparently forgotten instance in English practice is worth recalling, as it attracted little attention at the time of occurrence—the typhoid epidemic at Warrington in 1899, when 149 cases occurred. The pail, or rather, tub, system of conservancy was in force—without admixture and entailing exposure of faecal matter. The late Dr. J. Guest Gornall, who reported the facts of the epidemic, whilst not regarding flies as the sole means of conveyance of the microbe, held that "flies may carry particles of excrement and deposit them on food of any kind. The bacillus will thrive on fruit." He stated:—"It is not difficult, if indeed disagreeable, to imagine during that time that

tubs overflowing with liquid excreta, in course of removal, polluted yards, back passages, streets or even house floors; for, in case 129, you will read that the tub had to be carried through the kitchen." ....

The following statement by Major PATTON, I.M.S., Assistant Director, King Institute of Preventive Medicine, Madras (Second All India Conference Proceedings), should afford strong ground for improvement of conservancy in rural areas in India:—"The house fly of England did not exist in India. In the north there were two allied species. In Madras, the flies that breed in cow dung never go into the houses. They are an entirely different kind of fly, are blood suckers not biters, and have nothing to do with bazaars and houses. One undetermined species in Madras breeds round slaughter houses on the contents of the carcase of goats. The house fly in Madras breeds entirely in night soil. He had been engaged in this study for about four years.

FLIES AND ANTHRAX.

Experiments as to the possibility of transmission of anthrax by biting flies have been conducted by Mr. Bruin MITZMAIN, Veterinary Entomologist, Government of the Philippines. Infection by contamination of skin abrasions was not attempted; the effort being to secure evidence of transmission by biting flies from animals recently dead of anthrax. Guinea-pigs were also used to receive bites from *Stomoxys calcitrans* and *Tabanus striatus*, which had bitten animals from two and a half hours to ten minutes before death. Anthrax was thus successfully conveyed to guinea-pigs. The *Stomoxys calcitrans* was found to contain anthrax bacilli 14 to 17 days after biting, and the *Tabanus striatus* for 10 days.

SANITARY WORKS.

Artesian and Sub-Artesian Wells.

For many years the sole conception of artesian wells furnished in text books was a section of country of a basin shape so arranged that, at a great depth, water was represented confined between two impermeable strata, one end of which was higher than the other. With due regard to the action of a head of water, the upper impermeable layer was shown pierced by a boring, with the result that water was delivered in a splendid fountain at the ground level. No doubt such conditions exist in nature, but they probably are less often met with than those first described by Medlicott in the Memoirs of the Geological Department of the Government of India. He showed that typically favourable conditions for artesian action were obtainable when the configuration approached the condition of a pipe filled with water, having a gradient sufficient to give a good head when the lower end was closed; the result would be that on piercing the upper surface of the pipe at various points, water would rise in proportion to the head. These conditions he held existed in nature where, in the subterranean formation of a plain having a decided slope, water is confined between two impervious layers on its way to its natural outlet. In the upper portion of the tube so formed, in the instance, for example, of the water collecting area being a hill country, as the result of rain action and attrition would be large debris such as boulders, and in the lower or outlet end, the more readily transported finer grade of debris, such as gravels and sands; consequently, friction during water flow is comparatively small at the top of the slope, whilst at the lower end this is so increased owing to smaller voids in the stratum as to approach conditions obtained in the stopping of a pipe. In practice, the gaining of a well that will yield above the surface, and thus fulfil the term artesian, is sufficiently rare to render it unnecessary to speak of wells of this type otherwise than as bored wells.

From perusal of a note by the Sanitary Engineer to the Government of Bombay on "Artesian and sub-artesian supplies of water in Gujarát, read at the "Second All-India Sanitary Conference," the writer suggests that the conditions found in Gujarát are of the character discussed by Medlicott. The required collecting ground exists in the hilly tracts of Mahi Kantra and Panch Mahal, whilst the plains of Gujarát extending thence to the sea contain the impervious layers with boulder of limestone and other rocky debris at the upper portion, and fine gravel and sand towards the sea, the natural outlet of the subterranean water. Necessity of search for subterranean water in Gujarát arose from the fact that the subsoil water is largely brackish and, although rivers flow through the plains, their beds are at a depth from the general ground level which prevents their utilisation.

Mr. Belvadi (the Sanitary Engineer) shows that the first action taken in the Bombay Presidency as to sinking bored wells was by the Agricultural Department of Government. By making boreholes in existing shallow wells furnishing brackish water it has been possible in many

cases, by piercing the impervious layer on which the subsoil water rests, to secure an ample supply of sweet water. Mr. BELVADI explains, however, that the water thus obtained could not be considered free from risk of contamination from surface soakage; because the bed of clay through which the bores are made "does not extend to any great distance laterally." He holds that "the only hope of obtaining a potable supply of water in Gujarát is therefore "to go down considerably deep below ground level, so that water that has no communication with the surface except at the outcrop of the water-bearing strata several miles away from inhabited areas may be made available for use." Hence, the Government of Bombay sanctioned a series of experimental borings. As rocks or boulders were likely to be met with, the type of apparatus selected is capable of boring through rock. The following is Mr. BELVADI's description :—

"We have at present three steam and two hand drills at work. They are all of the Calyx type. One is an A.B.-1 drill, and its capacity is 4,000 feet commencing with a 14 inch bore, and two are F–1 machines capable of boring 800 feet commencing with an 8 inch bore. The hand drills are not capable of boring more than 250 feet starting with 4 inches. The Davis-Calyx drill is a rotary drill working on much the same principle as the Diamond drill; only, instead of a crown of diamonds for grinding away rock "chilled shot" is used. One great advantage of the Calyx machine is that it extracts a complete core of the strata drilled through, and affords more accurate information of the strata. Except when the cutting tools are dropped in the hole through carelessness, the machines give very little trouble and with a little training local mechanics will be able to work them satisfactorily. All plants excepting one were obtained from the Ingersoll-Rand Company through the India Office, London. One Sehram-Harker and Co's. improved combined percussive and rotary drill for boring holes commencing at 12 inches in diameter with percussion tools, and afterwards continued with the rotary process either with Ardox steel cutters or with chilled shot to a depth of 1,000 feet, finishing with a hole 6 inches in diameter has been indented for this year."

The first boring was made at Sanand. Up to a depth of 38 feet brackish subsoil water was met with resting on clay, below which were found alternate layers of fine sand and clay. Sand and gravel were found at 261 feet and the lining was continued in this layer for another 30 feet. Water rose to within 21 feet of the surface. A twelve hours pumping test gave 752,000 gallons.

But, after undergoing various forms of anxiety as to securing a successful boring, the troubles of a Sanitary Engineer by no means end with the victory of having struck water. The chemical analysis of the water may utterly condemn its use for domestic purposes. Thus, the Chemical Examiner to Government gave the following report on the water—per 100,000 parts, chlorine 70, free ammonia ·056, albuminoid ammonia ·044, nitrous acid ·230. The Sanitary Engineer states :—

"The presence of total solids and chlorine may be accounted for, as tertiary strata are known to contain strings and crystals of rock salt within their layers; but the presence of ammonia showing organic contamination cannot be accounted for, without a detailed examination of the catchment area from which the water is derived. This has not been done, as the bore has been abandoned for the present." . . . . . .

The next boring at Dholka gave the following analysis per 100,000 parts: chlorine 16, free ammonia ·002, albuminoid ammonia ·002, nitrous acid 0·23. In this case, the Sanitary Engineer makes the following remarks:—

"The Chemical Analyser has reported that the water may be used for domestic purposes in the absence of organic contamination, until other sources of supply containing less solids and less chlorine are available. The catchment area from which the supply is probably derived is free from organic contamination, and the excessive proportion of solids and chlorine are explained by the fact that Dholka was, at no geologically distant date, below the level of the sea. The presence of magnesium sulphate in large quantities goes to confirm this view. In the opinion of local residents the bore water is the best obtainable in the vicinity, and thousands of people have been drinking this water for over a year without any ill effects. The supply may therefore be considered potable."

The writer suggests that in deciding as to the potability of such water nothing but a full consideration of its composition as a chemical mixture fit for drinking, plus a survey of sanitary circumstances on inspection by the local Sanitary Officer or the Sanitary Commissioner with the Local Government, in each particular case, could secure a safe verdict. But similar trouble so surely follows the sinking of borings that it is well for the sanitarian, before giving an opinion, not only to take full account of sanitary and physical conditions within the drainage cone as interpreted by the data furnished by samples of strata passed through, but to remember the caution laid down by Dr. J. C. Thresh as to influence of contact of the iron lining of the bore in decomposing nitrates and thus producing ammonia.* Practical experience also dictates that a specimen of the water for chemical and bacteriological examination must be secured by a trustworthy person. It may well happen that a period may intervene between the striking of water and the determination to secure an analysis, during which responsible engineer officers and workmen may be withdrawn, and many changes may occur owing to evil treatment of the bore lining, the water standing within it and its surroundings by outsiders. Bad joints may lead to almost imperceptible leakage into the bore lining from the subsoil, and leaves and other undesirable additions to the contents may be made. Under such circumstances to take a specimen of water direct from the bore may be most misleading. Hence, it is essential that before a specimen is taken such conditions should be carefully searched for and, in any case, before abandoning a bored well solely on chemical analysis, it should be ascertained by prolonged pumping whether undesirable deposits of salts cannot be washed out of the subterranean soil. At times, the chemical characteristics of the yield of bored wells may be thus vastly improved.

According to a brochure recently published by the Bombay Government ("Some Recent Sanitary Developments in the Bombay Presidency") sinking in great depths of alluvial soil is not without its difficulties; thus it is stated:—

"There are also very considerable technical difficulties in insuring a continuous supply of water in the alluvial soil of Gujarát, because of the necessity of driving casing pipes the entire distance from the surface to the water-bearing stratum, which in some parts is more than 1,000 feet deep. The pressure of the sand and clay increases as each foot is driven.

* "The Examination of Water and Water Supplies": Churchill.

The casing has therefore to be continually reduced in size, and, at last a point is reached where the pipe cannot safely be driven further."

It is nevertheless believed by the Bombay Government that shallow borings carried out with less expensive plants would be effective in providing village water supplies.

Bored Wells in Burma.

In several parts of Lower Burma and at least in one town of Upper Burma (Mandalay) bored wells have been in use for several years. In Lower Burma, as strictly alluvial soil is dealt with, the boring plant employed has been usually of the hydrostatic jet type. Work by this method is ordinarily very rapid; but the writer believes that, for exploratory work in search of subterranean supplies, it is safer to trust to the dry method—as less likely to cause risk of passing through water-bearing strata without their presence being recognised. Rangoon is particularly well provided with bored wells sunk in private or commercial interests. The question was last year considered by Sir Alexander Binnie, the water-works expert, as to whether these might not prove a desirable addition to the public water supply to meet the demands of its rapidly growing population, and thus save expenditure on enlarged mains or pumping plant in connection with existing gravitation works. He gave it in his opinion that ten million gallons could be obtained from bored well sources daily.

In Rangoon, the artesian conditions follow the type described by Medlicott. The supply stratum having a covering of clay is usually pierced at about 180 feet depth. Sir Alexander Binnie does not regard the charging of this stratum of water as due to local rainfall, but to a collecting area in the distant Pegu Yoma Hills. In his Report to the Rangoon Municipality on the subject of quality of this water, he points to the fact that the subterranean water is under tidal influence as shown by a rise and fall of 10 to 12 inches, and warns that by excessive pumping the drainage cone might be so extended as to bring about brackishness. He considers that borings in the recognised water-bearing stratum will not be subject to contamination from the subsoil, owing to the continuity of its impervious clay. This conclusion he was doubtless able to arrive at as a result of a study of the numerous existing boring wells—over sixty in number—at his disposal. Thus, carefully considered, a safe opinion can no doubt be given, but in ordinary cases it is well to beware, as Mr. Belvadi (in the preceding Note) suggests, that at times the clay may not "extend to any great distance laterally."

Sir Alexander Binnie gives very little ground for his belief that the Rangoon subterranean supply is obtained from the permeable area of the Pegu Yoma hill range, although there is no reason why this should not be the case. As Rangoon is situated upon alluvial deposit, there also would seem no reason why the water-bearing stratum may not be an old bed of the Rangoon river. The formed delta shelving to the sea distant many miles would thus supply the high friction exit to the outflow necessary for artesian conditions. At Rangoon, at intervals, are felt "earth tremors" which are not classed with seismic disturbances, but by some are ascribed to the

sudden fall of masses of deposited alluvium to lower levels in the sea. Changes brought about in this or other manner to the exit end, on the analogy of the Medlicott tube theory, are worth holding in mind, when determining whether artesian conditions are probable and, if so, are permanent; for example, if a physical change occurs so as to cause an abrupt cutting of the delta at the sea outlet of the subterranean water, the artesian conditions are rendered much less likely than if there existed a prolonged shelving bank. As a sample in delta formation of the former condition the coast of Madras at Masulapatam and, of the latter, at Cocanada may be mentioned.

Sir Alexander Binnie's advice to utilise bored wells to obtain so large a supply of water as ten million gallons daily as an auxiliary to the existing supply must be of great and permanent advantage to Rangoon, as well as awake new interest in the use of bored wells for purposes beyond those of institutions and manufactories, to which their employment has hitherto been largely confined.

A Cheap System of Well-Boring.

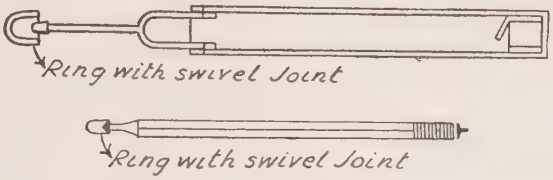
As suggested by the Bombay Government, where village supplies are concerned cheap apparatus is desirable. This opinion is reflected in a pamphlet published by Rao Sahib Pandit Matadin Sukul, M.A., Executive Engineer, Public Works Department, Eastern Bengal and Assam. He confines his suggestion to borings not exceeding 200 feet. Wells have been sunk by him in Sylhet and in Sibsigar, Jalpaiguri and Dinajpur Districts. He states:—

"The cost of borings according to the existing systems, both from the points of view of the cost of tools and their working, being very expensive and almost prohibitive to men of ordinary means, the improved system as described in these notes reduces the cost of both tools and their working to almost an insignificant figure, so that anyone with ordinary means and unskilled labour may be able to undertake trial borings or reclaim existing wells which yield insufficient supply, as has been actually done by the Government and the public in wells at Rampur, Boalia and Natore in the Rajshahi District."

He maintains that for borings of less than 200 feet, the lining may be very economically arranged for. Thus when the depth is but 15 feet, he considers bamboo pipes would suffice. Beyond this depth, he would use "a steel pipe lap-welded $3\frac{3}{4}$ inches inside diameter, with its sides $\frac{1}{8}$ inch to $\frac{3}{16}$ inch thick." According to his system of boring—"a chisel or jumper of steel with one end flattened, and the other end turned into a ring for rope attachment is used for cutting a hole in soil, and a tube with a valve opening upwards fixed at one end and a ring for rope attachment at the other end, similar to the jumper, clears the hole of cut earth and running soil and sand and water. This tool is usually called *shell auger*.* Three or four men raise the jumper

* A copy of Mr. Matadin Sukul's diagrams of these tools is attached: excluding the swivel joints, the chisel is stated to be from 3 feet to 5 feet long, and the shell auger 3 feet to 4 feet long.

two or three feet and drop it, cutting earth of any hardness and smashing even stones and boulders. If the hole be dry, a little water is



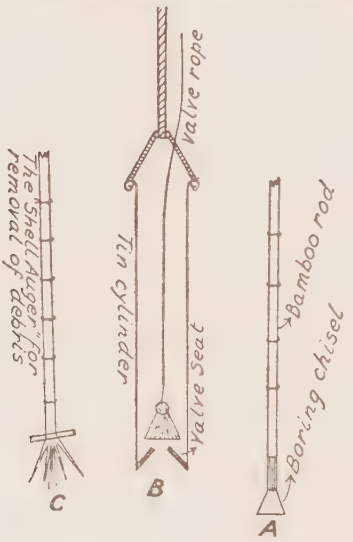
poured into it to convert the cut earth into mud and the shell auger is similarly treated; that is, when pulled and dropped, the auger removes the soil, the mud rushing up raising the valve and closing it at each dropping and raising of the tool."

The Executive Engineer, the writer thinks, is wrong in considering this a new method. The Chinese are credited with boring by the rope and chisel in olden days up to 1,000 feet. The improvement he proffers however, is in the character of the rope he employs, namely "galvanised flexible steel wire rope composed of 6 strands by 24 wires, with hempen core on each strand in a centre of rope, weighing approximately $1\frac{3}{8}$ lbs. per fathom and having a breaking strain of 4 tons." The tools required according to the Executive Engineer for 100 feet, 150 feet, and 200 feet boring would cost Rs.300, Rs.380, and Rs.450, respectively. So that he certainly has met the requirement of cheapness. He considers the daily rate of progress should be from 64 to 12 feet at a cost (coolies wages 5 to 6 annas per hour) from 12 to 6 annas per running foot. Mr. Matadin Sukul's brochure, "Improved System of Boring or Testing for Water for Agricultural and Drinking Purposes," was printed at Shillong, Assam, by the Superintendent, Government Press (price 12 annas), and is well worthy of perusal by sanitarians advising local authorities afflicted with "want of funds."

The Makeshift Bored Well.

Whilst Mr. Matadin Sukul's method will, within the depth named by him, serve an important sphere, there remains the possibility of making borings at less depth in alluvial or gravel strata at even cheaper rates. At Yenangoung, Burma, is an important petroleum oil field worked largely on the most advanced American methods. The Burmans in the neighbourhood are therefore acquainted with the principles involved in making a boring. There the writer found a bored well sunk in gravel of over thirty feet in depth, which had been made for the use of his household by an ingenious Burman with the simple implements shown on p. 472. A is a bamboo shod with ron or steel. With a hammering and twirling motion and little exertion the single labourer necessary loosened the gravel. This accomplished, it was removed from the bore by means of a bamboo split at the end and with the parts held apart by inserting another piece of bamboo transversely through the split portion. These split portions retained a certain amount of elasticity, and when thrust over

the gravel debris at the bottom of the bore closed over it—very much as a human hand would do (c). The boring was lined in a square shape at the upper portion by thrusting teak planks into position. For the withdrawal of water, the crude but ingenious bucket B was employed. This was a cylinder made out of an old kerosine tin, open at both ends, but, in the distant end, guarded by a cone of tin with the apex removed. The cylinder was suspended by rope to allow of its being lowered to the bottom of the bore. There was, however, provided a



second rope held loosely in the hand till the bucket reached the bottom of the bore. To this rope was attached a cotton bag containing loosely packed clay. When it was considered the bucket was filled with water the cotton bag was by a motion of the rope allowed to descend over the cone, and made a sufficient though not fully water-tight valve enabling the bucket filled with water to be withdrawn.

Boring by this simple method to secure supplies from a lower stratum might often be of the greatest utility in subsoil wells which have become dry. In emergencies, travellers in the tropics might thus provide themselves with water. A section of a female bamboo could very well take the place of the tin of the bucket, whilst the natural arrangement of the joint of the bamboo would replace the cone forming the valve seat.

Reinforced Concrete for Open Drains.

In connection with anti-malaria measures in the Panama Canal area, "many walls of natural streams and ditches have been lined with concrete." In June, 1913, it was reported: "More recently the plan adopted was to make this lining only about an inch thick reinforced at the centre with poultry wire. Such construction has given satisfactory service, and the smaller cross-section reducing the cost per linear foot has enabled more work of this character to be accomplished." The writer believes this cheap and effective form of concrete lining is likely to receive a welcome where the "want of funds" impedes anti-malarial work.

The following Rules concerning concrete lined drains issued by the Isthmian Canal Commission (Circular No. 183–F 3), being the outcome of much special experience, are likely to be of utility to Sanitary Officers :—

"Whenever seepage water outcrops near or at the sides of ditches, sufficient weep holes shall be built into the concrete lining. Such weep holes shall be located in the side walls only. They shall slope downward toward the surface of the ditch floor.

"Key walls shall be used where necessary and when specified on approved plans. A weep hole shall be located in the concrete ditch wall, close to and on the upstream side of each key wall.

"Whenever a pipe line crosses a ditch (and is in the plane of its cross-section, thus acting as an obstruction) the ditch shall be widened at such place before the concrete lining is installed.

"Where possible, branch ditches shall enter the main concrete-lined ditch at an acute angle, and the main ditch shall be made wider at such points.

"On sharply curved sections of ditches, the outer wall shall be raised to prevent the water climbing over it.

"At the junction of a branch and a main ditch, the wall opposite outlet of branch shall be raised.

"It shall be the duty of the Sanitary Inspector to list all necessary repairs to concrete ditches at the end of each rainy season, and have such work accomplished during the dry season, so far as possible."

VITAL STATISTICS.

The Census of India.

In the Report on the Census of India (1911) by Mr. Gait, C.S.I., the influence of plague mortality in that country is thus stated :—

"It is impossible to make any estimate of the direct and indirect effects of plague on the growth of towns, but it is quite certain that they have been enormous. . . . If it be accepted that the mortality of the decade apart from plague was normal, it follows that but for this disease the population at the Census of 1911 would have been greater than it was by 6·5 million. In other words, the population would have increased 9·3 instead of 7·1 at present."

Putting aside questions of organisations employed to meet plague, which have differed in various parts of the country, as well as the habits of the people and various factors connected with rats and fleas, the extent to which passengers and trade traffic is centripetal or centrifugal—the question of whether populations reside largely in towns or in villages, the degree to which these are scattered and the density of their populations must have affected the facilities for spread of this disease. The Report furnishes the following facts which show how greatly the urban and rural populations vary in different parts of India :—

The total Indian Empire has an area of 1,802,657 square miles, of which 1,093,074 are under British administration. "The area is therefore equal to the whole of Europe without Russia." The population of the whole of India amounts to 315,156,396, of which 244,267,542 are within British Territory. 72 per cent. of the people is engaged in agricultural pursuits. Only 9·5 per cent. lives in urban areas, as compared with 78·1 per cent. in England. Mr. Gait classes all places having populations exceeding 5,000 as urban (towns) and others as rural villages.

Only 3 per cent. of Assam is urban. The average village contains 233 inhabitants.* In Bengal 6 per cent. of the population is urban, and if Howrah and Calcutta be excluded the percentage does not exceed 4. The average village contains 352 inhabitants. There are 124 towns containing an average of 24,000 inhabitants. In Bombay, 18 per cent. of the population is urban and 82 per cent. live in villages. In Burma, 9·3 per cent. of the population is urban. In Madras 11·7 per cent. is urban ; half of the total rural population live in villages of 500 to 2,000 inhabitants. 280 towns afford an average of 17,570 inhabitants. In the Central Provinces, 8 per cent. of the population is urban. Nearly one third of the population live in towns of over 20,000 and one third in towns of 5,000 to 10,000 inhabitants. In the Mahratta Districts, more than half live in villages of 500 to 2,000 inhabitants. In the North West Provinces, 13 per cent. live in towns having an average of 15,000 inhabitants. In the Punjab 10·6 per cent. of the people live in towns and 89·4 in villages. Half the rural population reside in villages of 500 to 2,000 inhabitants, and one-fourth in those of less than 500.

*This is an area where plague has made little progress.

Infantile Death Rates.

In Trinidad, during 1913, of total births the illegitimate rate was heavy, namely, 68·76 per cent.; in St. Vincent it was 38, in St. Kitts 24·7, in Nevis 25, in Anguilla 26·6, and in Grenada 53·9 per cent. In the Report on the Leeward Islands Colony for 1912, by Dr. W. H. Fretz, it is stated :—

"The importance of illegitimacy as a calamity and its effect on infantile mortality is evident. It is beyond doubt that fewer illegitimate children grow up to maturity than children born in wedlock; it doubles or even trebles the chances of an infant dying before it reaches its first birthday. Illegitimacy is in itself an evil to a man, and one should seek to diminish the number of their births."

This, of course, is the case, and as the infantile death rate in Nevis is 269 per mille of births, the reason might well be applicable.

In Trinidad, however, Surgeon-General Clare gives the following explanation of the large amount of illegitimacy; so that if the Indian population is found largely in the smaller islands, it may well be that not parental neglect but parental ignorance in the midst of insanitary environments is the *fons et origo mali* :—

"The illegitimacy birth-rate of the total population has advanced slightly from 68·45 to 68·76 per cent. of the total registered births—a high percentage rate prevailing especially amongst the East Indian section; but the Registrar-General explains this by the fact that many East Indian marriages which are solemnised here according to the religious law and customs of the contracting parties are nevertheless not registerable under the laws of the Colony, and therefore the issue of these marriages are illegitimate."

It is, of course, possible in the class of Indian immigrants found in the West Indies that irregular matrimonial arrangements occasionally exist; but it is well to understand that, in the case of the average respectable Hindu, not frivolity but deep religious conviction alone leads to the expense of a second and, at times, more marriages, and that they are contracted only after earnest consideration of the necessity. Parental neglect, the accompaniment of Occidental illegitimacy, is not likely to be an ordinary factor in infantile mortality amongst Indians—on the contrary, beyond ignorance of infant hygiene, much is due to application of crude measures of prophylaxis. In due course, presumably, methods of registration of Indians in the West Indies will be more or less in conformity with those recently adopted in South Africa.

Anguilla as a Sanitarium.

Statistics issued with the Medical Report for the Leeward Islands Colony for 1913 show that Anguilla has possibilities of being made particularly healthy by modest efforts. In 1911 the death-rate was only 14·8, and in 1912 18 per mille with a birth-rate of 34·8, and an infantile death-rate of 142·8 per mille of births; against 269 per mille of births, and a total mortality of nearly 31 per mille of St. Kitts. The rainfall in Anguilla in 1912 was 27·46 and in 1911 32·17. The representative temperature of the group of Islands shows that there is no excessive fluctuation, the mean minimum being 76·90° and the mean maximum 82·65°. According to Dr. Burton "there

are no overcrowded villages and the sanitary conditions in and around the dwellings are on the whole satisfactory. A few cases of imported malaria exist, but other tropical diseases are conspicuous by their absence." Evidently the little island of Anguilla might have a great future before it, if it could further improve its sanitary condition and persuade the profession to use it as a sanitarium.*

*According to the Colonial Office List Anguilla, lying 60 miles to the north-west of St. Kitts, is 16 miles in length, and 3 to 1½ in breadth, containing 35 square miles. It is said to suffer from want of an adequate water supply.—[Ed.]

Book Reviews.

Muirhead (W. Alex.). **Practical Tropical Sanitation. A Manual for Sanitary Inspectors and others interested in the Prevention of Diseases in Tropical and Sub-Tropical Countries.**—xv + 288 pp. With illustrations. 1914. London: John Murray. [Price 10/6 net].

Staff-Sergeant W. A. Muirhead, R.A.M.C., at present Assistant Instructor at the Army School of Sanitation, Aldershot, is the author of the above book, which is dedicated to Sir Ronald Ross as "the apostle of Tropical Sanitation."

The work is meant specially for the instruction of Sanitary Inspectors in the tropics, but, as suggested by the author's addition of the words "and others," will doubtless fulfil a sphere of utility in the supply of practical information to laymen. Indeed, medical officers of health will find in the several forms employed, and the opinion of the author as to what Sanitary Inspectors can do during hours of duty, first-hand information of value.

The author has managed to compress in less than 300 pages an unusual amount of matter; and whilst this is a great virtue, it is probable that in a second edition some expansion of a few subjects would enhance utility. For example, at page 86, in treating of ankylostomiasis, he omits all mention of the rôle of damp earth in favour of water. "Embryos, forming in four or five days, eventually find water and there live until they reach the next host." In describing public water filters, no mention of methods of regulation of filtration speed is made. The book is rich in neatly designed diagrams and illustrations from photos. To a diagram representing herring-bone drainage of swamps the reviewer would, however, take exception. It is not advisable, as there shown, to make the outlets of lateral drains discharge into the main drains directly opposite each other.

The work is particularly welcome at the present time—as showing the fast growing opinion of the importance of possessing certificated sanitary inspectors specially trained for duty in the tropics, if our Dominions beyond the seas are to be saved from preventible diseases. The Sanitary Inspector is "the man behind the gun," and no accumulation of expert knowledge in the various 'ologies on which hygiene is founded, can be of permanent use to communities until trained executive staffs are at disposal.

W. G. K.

Purvis (J. E.), [M.D.] & Hodgson (T. R.), [M.A.]. **The Chemical Examination of Water, Sewage, Foods and other Substances.** Cambridge Public Health Series. 228 pp., 1914. Cambridge: At the University Press. [Price 9s. net.]

The authors state that this book, one of the Cambridge Public Health Series, is intended for the use of students who are attending courses of instruction for diplomas and degrees in Public Health and for those who are studying the chemistry of water, sewage, foods, disinfectants, etc. It describes the methods of examination which have been used and tested by the authors, one of whom is a Public Analyst. The subjects treated include water, sewage and sewage effluents (79 pages); milk and its products; butter and other fats; tea and similar beverages; lime juice; poisonous metals in foods; preservatives, etc. The book is handy and well printed and seems to be efficiently indexed. The position of the authors ensures the accuracy of the information.

A. G. B.

Errata.

Bulletin, Vol. 4, No. 4, p. 190. Second paragraph, 8th line, for "*in the case of khals of a permanent character*" read "*in the case of bheels of a permanent character.*"

Same Number, p. 236. Second paragraph, 5th line, for "persons about to visit houses locally" read "persons about to rent houses locally."

BUREAU NOTICES.

Works in the Bureau Library may be consulted between 10 and 5.

The Director can be seen between 10 and 1; for a later hour an appointment should be made.

The Director will be glad to receive early copies of works, or reprints on Tropical Diseases for notice in the *Bulletin* and for the Library. To be addressed—Tropical Diseases Bureau, Imperial Institute, London, S.W.

(Telephone:—Kensington, 5188.)

Reprints of Papers have been received from:—

STRONG (Prof. R. P.); SWELLENGREBEL (Dr. N. H.); TOWNSEND (C. H. T.)

BOOK RECEIVED.

REICHE (Carlos): La Vegetacion en los Abrededores de la Capital de Mexico.—143 pp. With 27 text-figs & 1 map. 1914. Mexico: Tipografia Económica. 2ª de San Lorenzo 32.

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